Self-interest against climate change

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> ‘This Agreement . . . aims to strengthen the global response to the threat of climate change. . . by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.’

Nearly all the nations of the world approved this agreement in Paris in December 2015. There was jubilation among the delegates.

They did not mean it. At least, many did not. To take one example: within days after the Paris Agreement, the UK government drastically cut its subsidy for installing solar panels. It also issued licenses for fracking in many parts of England, with the aim of opening up new reserves of fossil fuel. And, still within days, it removed the tax advantage it had previously given to low-emission cars. Yet, before the Paris meeting, the Intergovernmental Panel on Climate Change had made it plain that the 2 degree target could be met only by the most stringent action to control emissions. Obviously the British Government never meant to do as it had promised.

There is little sign that the world as a whole is taking much notice of the Paris Agreement. Greenhouse gas emissions are still growing, though it is true that their growth has slowed a bit. In support of the Agreement, countries made pledges to the United Nations to reduce their emissions. These pledges taken together are not enough to meet the target the countries agreed on: if all pledges were fulfilled there would still be a median increase of 2.8 degrees by 2100, according to Climate Action Tracker. Nothing says that temperatures will stop increasing after that date, going even further beyond the 2 degree target. Moreover, few countries are on course to meet even their pledges. Only a few have policies that Climate Action Tracker reckons are compatible with 2 degrees of warming.

I shall give another example of egregious inaction. Australia has more emissions per capita than even the US, and this does not take into account the contribution Australia makes to climate change by exporting 380 million tonnes of coal per year. It joined the US and Brazil as one of the villains of the 2019 Madrid COP 25 meeting of the United Nations Framework Convention on Climate Change. Australia’s particular villainy was to cheat on its figures. It has pledged to reduce its emissions to 26–28% below 2005 levels by 2030. This is a very modest target and puts its 2030 emissions above its 1990 emissions. (Compare the European Union, whose 2030 pledge is 40% below its 1990 emissions.) In Madrid, Australia announced that it would use something called ‘Kyoto credits’ to meet about half of this pledge. Kyoto credits have nothing to do with the Paris Agreement, and this manoeuvre is almost universally recognized as simply cheating. In effect, it is double-counting reductions in emissions. Moreover, although the Australian government asserts that it is on track to meet its pledge ‘at a canter’, there is no evidence for this assertion. Australian emissions have been increasing since the Coalition government repealed Australia’s carbon tax in 2013. Given its present policies, they are projected to continue increasing.

The striking thing about Australia’s attitude is that it is one of the countries that are most vulnerable to climate change. Australians live on the habitable fringes of a hot dry continent, which is expected to become hotter and drier. They have always suffered droughts, but before the fires many areas had been enduring the worst drought they had ever recorded. While the Australian delegates were speaking in Madrid, back home their country was on fire. A few

weeks later, as the disaster grew, in one place a thousand people were driven by fire on to a beach, from which they were rescued by the navy five days later. It was like a wartime evacuation. By the end of the season, 18 million hectares of Australia had burned. Nothing like this had ever been experienced before.

We sometimes assume that, when things get bad enough, our governments will eventually take action against climate change. But the Prime Minister Scott Morrison, after being forced by the fires to return from a secret vacation in Hawaii, said he would not be pushed by environmentalists into making what he called 'reckless' cuts to the coal industry. Australian climate change policy remains unaltered even though a poll taken in November – before the fires grew to cataclysmic proportions – showed that two-thirds of Australians favour a stricter policy. The reason is the tremendous power of the coal industry in Australia. Coal is the country's second-largest export, and it directly employs over 35,000 people. The government is still trying to open a new coal mine in Queensland, which would be one of the biggest in the world.

I am reminding you of these depressing facts, for two reasons. The first is to make it clear that the international effort to bring climate change under control is failing. Indeed, we may fairly say it has failed. This effort has been in train since at least the Rio Earth Summit in 1992. After almost 30 years, emissions of greenhouse gas in the world as a whole continue to soar. They have diminished in several countries, but only a very few countries have adopted policies that are commensurate with the challenge we face. I think it's plain that we need to do something different.

The effort so far has rested on a moral appeal. Because of the greenhouse effect, our emissions of greenhouse gas are causing great harm to other people. On moral grounds, we should therefore reduce them. The Stern Review in 2006 recommended us – the current generation – to sacrifice a small amount of our consumption, because a small sacrifice now would bring much greater benefits in the future. However, the benefits would come mainly to future generations, whereas the present generation has to make the sacrifice. Why should we do so? It can only be because of our moral responsibility towards future people.

And now Greta Thunberg makes the same moral demand. She does so with much more force and indignation because she is a great orator and a representative of the generations we are harming. 'How dare you!' she says:

> You are failing us, but the young people are starting to understand your betrayal. The eyes of all future generations are upon you and if you choose to fail us, I say: We will never forgive you.

She is right, of course. Climate change is a great moral wrong perpetrated by some people on others – in particular, by the old on the young. She is absolutely entitled to her indignation. I do not for a moment suggest that the moral appeal is mistaken or incorrect. Moreover, I think these are things that should be said loudly. Whatever happens, our governments need to be pushed into action against climate change, and protests in the streets are a powerful way of applying pressure. However, I think the appeal to morality is not so effective that it can achieve its aim of bringing climate change under control. To do that we need a different approach.

Many individual people are moved by the appeal of morality. They are willing to make a sacrifice for the sake of future people. Many of the moral philosophers who work on climate change aim to persuade us to lead an environmentally more virtuous life, and many of us do as they recommend. We insulate our houses, eat less meat, reduce our travel and so on. Emitting greenhouse gas is an injustice: we do harm to other people when we do it, so we

shouldn't do it, and many of us respond to that realization. However, individual morality will never solve the problem of climate change, just because not enough people will do as morality requires. Moreover, to reduce our emissions substantially we need big changes in our economic infrastructure, and we cannot make those changes as individuals.

To solve the problem of climate change, governments need to act as well as individuals. Governments have the coercive power to impose regulations and taxes to make sure that everyone responds as they should to climate change, not just the few people who are morally motivated. But the problem is that many governments are impervious to morality. This is the second point I mean to draw from the stories I told you about Britain and Australia. Governments prevaricate; they lie; they cheat; they make promises that they do not intend to keep; and they really don't care about the future. To some extent governments are responsive to the moral motives of their people, but not to a great enough extent. Democratic governments are supposed to be responsive. But, even though most Australian people want action on climate change, their government takes no notice. It is influenced more by the coal lobby than by the electorate. And the largest emitter of greenhouse gas is China, which is not a democracy at all.

The great economist A. C. Pigou wrote in 1920:

> The State should protect the interests of the future in some degree against the effects of our irrational discounting and of our preference for ourselves over our descendants. . . . It is the clear duty of Government, which is the trustee for unborn generations as well as for its present citizens, to watch over, and . . . defend, the exhaustible natural resources of the country from rash and reckless spoliation.

But the boot is actually on the other foot. It seems to be governments that do not care about unborn generations even when their public does.

So long as there are powerful interests opposed to controlling climate change, governments will not act as they should. Morality will never motivate them. So the only way we can achieve a satisfactory outcome is to make sure that it is no one's interest to oppose action. I think this is what we should aim for now. We should not ask anyone to sacrifice her interest for moral reasons. We can then harness the powerful motive of self-interest to drive action on climate change. And the main point I want to make is that this can be done: climate change can be controlled in a way that requires no one to make a sacrifice. This means no one – not even the owners of fossil fuel resources and workers in coal mines.

None of them need suffer.

This may come as a surprise to you. The moral approach has been pursued for so long that we are used to thinking the current generation has to make a sacrifice for the sake of the future. But that is not so. So much good will be done by bringing climate change under control that there is enough to go round everyone; no one need suffer. It has only to be distributed correctly. If we did make a sacrifice of our present consumption for the sake of cleaning up the air, the benefit would naturally accrue to people in the future. But we can transfer some of that benefit back in time to us, enough to compensate us fully for the sacrifice we make, and leave us at least as well off as before. As well as transfers of benefit between generations, there will also need to be transfers within a generation from those who benefit from reducing climate change to those who do not.

How do I know this?

I know it in principle from economic theory. The theory tells us it is so because greenhouse gas is what economists call an 'externality'. When you do something that causes an emission of greenhouse gas, the gas spreads around the world and does harm – generally only a little

bit of harm – everywhere in the world and over a very long stretch of time. All this harm is part of the cost of what you do. But you do not bear this cost: it is borne by all the people who suffer harm. So you do not take the full cost of your activity into account in deciding whether to do it. The consequence is a sort of inefficiency in the economy.

According to standard, elementary economic theory, it is what is called 'Pareto inefficiency'. A situation is defined to be Pareto inefficient if it's possible in principle to change things within the economy so that at least one person ends up better off without anyone's ending up worse off. According to standard, elementary economic theory, an externality such as greenhouse gas normally makes our situation Pareto inefficient. So it is possible to respond to climate change in a way that makes at least one person better off without making anyone worse off. No sacrifice is required from anyone.

That is what I used to say, and many economists still say it. However, it is not actually true, because the standard, elementary economic theory does not apply to intergenerational externalities such as greenhouse gas. Some of the harms that are caused by our present emissions are suffered by people in later generations, and this invalidates the theory.

The reason is that whatever we do about climate change will alter the make-up and almost certainly the size of the world's future population. If our governments take any serious action on climate change, they will alter the way we live our lives. For example, they will make it harder and more expensive to travel. This will alter society: people will live more locally. They will meet and have babies with different people, they will have babies at different times and they will probably not have exactly the same number of babies. The result will be that the next generation will be made up of different people and different numbers of people from those it would have been made up of had our governments done nothing about climate change.

This means the standard economic theory does not apply. It applies only when there is a fixed population of people with fixed preferences. To see why the theory fails, let's take an exaggerated example. It's not meant to be plausible; I'm using it only to show that the theory can deliver a false conclusion. Suppose that, for some reason, the government's climate-change policy causes the birth of more people who are congenitally unable to enjoy a good life. For example, perhaps there is more inbreeding because people travel less. Then the policy will not be able to ensure that all the members of future generations are better off than they would otherwise have been.

So the theory needs to be repaired, and it can be. We need to adopt a notion of efficiency that is different from Pareto efficiency. It needs to be one that is not based on the wellbeing of future people – how well off they are – but on the resources that are available to them. We say that a situation is inefficient if it is possible to change things in the economy so that some existing people are better off, no existing people are worse off, and the resources that are left to future people are at least as good as they were before. I call this new notion 'resource-constrained efficiency'. It can be shown that externalities – including intergenerational externalities – normally cause inefficiency in this sense.

This means that climate change can in principle be controlled in a way that makes no presently living person worse off, and leaves future generations with just as good resources as they would have had. In this sense, responding to climate change requires no sacrifice. It needs stressing again that achieving this result will require some redistribution of resources between people. This includes redistribution between generations. Later I shall explain how we can achieve a no-sacrifice result in practice.

I think our approach to climate-change policy should be constrained by the condition that is

requires no sacrifice. Since controlling climate change will generate a lot of benefit, accepting this constraint still leaves choices. The surplus benefit can be distributed to make present people better off or give better resources to future people, or both.

Nevertheless, there are two strong objections to adopting this constraint on policy. First, it will leave the world with economic maldistribution, and second it will perpetuate injustice in the world. I shall explain and respond to these objections in turn.

Maldistribution first. It is natural to think that, if we accept the no-sacrifice constraint, our policy on climate change should aim at the best possible result within that constraint. This aim implies achieving the best distribution of wealth and income within generations and between generations. But the no-sacrifice constraint will prevent us from achieving the very best result; without the constraint we could do better. The constraint implies some maldistribution, therefore. That is the objection.

We need to think about two sorts of maldistribution: intergenerational and intragenerational. I start with intergenerational maldistribution.

Several economists have calculated how much effort should go into dealing with climate change, if we aim for the best result overall. Their method is to maximize a value function, which is some aggregate of the wellbeings of present and future people. It is debatable what form the value function should take. Should it discount future wellbeing, for example? But the form does not matter here. What matters is that the conclusion of this maximizing exercise is often that the best result involves the present generation's making a sacrifice. That is to say, the best intergenerational distribution implies some transfer of wellbeing from the present generation to the future.

This is where we started. For almost thirty years we have been urging the present generation to make a sacrifice for the future. Economic models such as the Stern Review have been used to reinforce this appeal: they show that a sacrifice would lead to the best result. But this moral appeal hasn't worked. The present generation, as represented by our governments, will not make the sacrifice. That is why I now recommend a different approach. We have to accept that it will not lead to the best intergenerational distribution.

What about intragenerational maldistribution? The world is grossly unequal. In recent decades, climate change has exacerbated this inequality because it is mostly better-off people who gain benefit by emitting greenhouse gas and mostly worse-off people who suffer from the consequences. On average, an American emits about 16 tonnes of greenhouse gas a year; a Tuvaluan about 1 tonne. But Americans' lives have so far changed little as a result of climate change, whereas Tuvaluans are faced with losing everything they have. They live on low-lying islands that are being eroded by rising sea levels and may soon become uninhabitable.

The world's inequality is a very bad thing. So if we choose our climate change policy with the aim of producing the best result, we will choose a policy that involves some redistribution from better-off to worse-off people. However, if we impose the no-sacrifice constraint, it will prevent this redistribution. The distribution will therefore end up worse than it would have been without the constraint.

But again, this can't be helped, since people will not accept a sacrifice. The world is beset by many problems. Climate change is one; inequality another. These problems do not all have to be solved together. We should not saddle our response to climate change with the additional task of being a response to inequality. If we do, we shall end up with no successful response to either. If climate change was the cause of inequality, it might be right to tackle the two problems together. But it is not. The world's inequality results from centuries of unequal

development, and from colonialism. Climate change is too recent a phenomenon to have made much difference to inequality. Three or four decades ago climate change was just becoming noticeable, but the world's gross inequality existed a century before that.

In sum, the problem of maldistribution is serious and unfortunate, but it is forced on us by the failure of the appeal to morality.

Maldistribution is often referred to as distributive injustice, but what I mean by the problem of injustice is different from that. When you do harm to another person, you do her an injustice unless there is some exculpating circumstance – for example unless you do it in self defence or with the person's consent. Our emissions of greenhouse gas harm other people, and there are no exculpating circumstances, so they are unjust. If we adopt a no-sacrifice response to climate change, we shall do nothing to overcome this injustice. That is the objection.

It is a correct objection. Suppose a bully regularly inflicts unjust harm on other people. And now suppose the bully is paid to stop doing this harm. The harm stops, which is good for the victims, and the bully is better off because she has been paid. So everyone is better off, but the justice has not been overcome. The bully put herself in a position of advantage through her bullying, and the payment perpetuates her advantage. It perpetuates the injustice.

The no-sacrifice constraint is like that. Those who emit greenhouse gas are unjustly advantaging themselves by their emissions, inflicting harm on others. Under a no-sacrifice policy to control climate change, they are paid enough to make it worth their while to stop their emissions. Their unjust advantage is perpetuated.

Among the people who cause emissions of greenhouse gas, many do so innocently, not realizing the harm they are doing. But there are also many who do so knowingly. Some do so knowingly on a very large scale, and do everything they can to continue the harm. I am thinking of leaders of the fossil fuel industry. Several of them are bad people: they tell lies about climate change, and they pay others to tell lies, in order to preserve their unjust advantage. Charles and David Koch, owners of the giant fossil fuel company Koch Industries, spent $127 million between 1997 and 2017 funding groups that engage in climate denial. Justice requires people like this to be punished, but under a no-sacrifice policy they will be rewarded.

I think this is the worst feature of a no-sacrifice policy. I am not happy with it. It sticks in the gullet, but we have to swallow it. These people have the power to prevent us from bringing climate change under control. They hold us to ransom, and I am sorry to say we have to pay.

Now I come to a more practical question. I claimed on purely theoretical grounds that a no-sacrifice policy is possible. But you might reasonably wonder how. I said that, since the benefits of controlling climate change naturally accrue to future generations, a no-sacrifice policy will involve transferring these benefits back to presently living people. How can benefits be transferred backwards in time like that?

This is not as puzzling as it may sound. We transfer benefits backwards by not transferring benefits forwards. We of the present generation are in control of the resources that will be available to future people. We consume some of them, and pass the rest along to them. If we choose, we can hold back more for ourselves.

A no-sacrifice policy does not require us to hold back more resources in total; it requires us to change the nature of the resources that we pass to the future. Each year, the global economy produces some income. We consume some of it, and we invest some of it for the future. As things stand, most of our investment takes the form of conventional capital goods

including economic infrastructure such as buildings, roads, power systems and so on. Some of those goods survive for a long time and constitute resources that we leave for future people. But we also bequeath to our descendants a dirty atmosphere. It would be preferable for them if we left them less conventional capital and a cleaner atmosphere. And we can achieve that result simply by changing the nature of our investment. Instead of investing in conventional goods, we can make green investments instead: we can insulate our houses, build windmills, solar farms and bike paths, and so on.

On a very crude picture of the situation, this requires merely a switch in the nature of our investment; it does not require any increased investment from us. So it seems no sacrifice would be required from us because we could keep our consumption as it was. If the world had a planned economy, the world government could simply switch the investment by command. In our actual world, investment is largely controlled by independent capitalists, so the switch would have to be orchestrated through the financial system. It could be achieved by government borrowing. A government could issue bonds, making the interest rate so attractive that the capitalists would prefer to buy bonds rather than invest in building conventional capital goods. So they would willingly lend to the government, which could spend the money on green investment.

But this is over-simplistic. The theory tells us that a no-sacrifice result is possible, but it does not tell us it can be achieved without any alteration in our consumption. To achieve a no-sacrifice result, the economy has to be reasonably efficient, whereas switching investment without changing consumption would be inefficient because our present investment is geared to our present consumption. There will have to be more profound changes than a mere switch in investment. We shall have to consume different, greener goods. However, the theory does tell us that our altered consumption can be just as good as before, so we need not make a sacrifice.

As any economist knows, when we are dealing with an externality we cannot hope for efficiency unless the externality is ‘internalized’ as they say. An emission of greenhouse gas has an external cost, which the emitter does not take into account when choosing to emit. If she is to take the external cost into account properly, she must herself bear a cost for emitting that is equal to its external cost. That is to say, there must be a carbon price equal to the external cost. A carbon price is essential if we are to achieve reasonable efficiency, and thereby avoid sacrifice. (There must be a price on all greenhouse gas emissions, but for brevity we generally speak of carbon dioxide only.)

There is more than one way to set a price on carbon, but the simplest way is by tax. The government can impose a carbon tax. This provides an incentive for consumers to start consuming less carbon-intensive goods. If the tax rate is right, it will move us to efficiency. However, this doesn’t mean making everyone better off. The tax will hurt those who emit a lot of carbon dioxide, and that predominantly means presently living people. The tax will benefit future people because their air will be cleaner. So if no one is to make a sacrifice, there will need to be a transfer of resources from future people to present people, enough to compensate present people for the cost of paying the carbon tax.

A sort of redistributive taxation will be required. Governments will need to tax future people and use the revenue to subsidize present people. How can they tax future people? Answer: by borrowing. A government debt is in effect a commitment to raise taxes on future people, in order to repay the debt. The government can sell this commitment in the form of bonds, and use the revenue it raises to compensate present people to the extent of making them no worse off than before. For this purpose, remember that the government will already

have available the revenue it raises from the carbon tax itself; government borrowing will constitute additional revenue.

How can a government actually compensate people by means of this revenue? Reducing other taxes such as income tax will do for most people. There will also have to be big subsidies to shareholders and workers in the fossil fuel industry. Unfortunately, governments cannot target exactly the right amount of compensation to each individual. They can only deal with broad classes of people. Consequently, I'm sorry to say it will not be correct to say that no single individual will end up making a sacrifice. But it is approximately correct: no class of individuals needs to make a sacrifice.

You might still be puzzled. How does the financial process of borrowing and spending move real resources from future people to present people? By the working of the market. Present people will spend their subsidies on present goods, and that will divert resources away from conventional investment. Consequently, less conventional resources will get through to future people.

All this shows that we shall not in practice be able to implement a no-sacrifice policy except by means of borrowing. This poses a new problem. The no-sacrifice approach to climate change will require a new era of increasing public debt. But many governments are not sufficiently creditworthy to be able to borrow any more money than they do already.

Even some governments that are well able to borrow are disinclined to do so. Public debt has acquired a bad name in many countries; in the last decade many European countries have been imposing austerity on their people even though they could instead have borrowed at a ludicrously low rate. They could have borrowed and invested massively in reducing climate change, but they refused to do so on grounds of fiscal probity. Their reluctance has to be overcome.

Their fancied probity has now been blown away by Covid-19. Governments are throwing money into fighting the virus in amounts that were inconceivable a few weeks previously. They are willingly accepting the soaring public debt that will follow. Possibly this urgent health crisis may make them realize that money has also be spent on the more serious but less immediate threat of climate change. They may remember that there are worse things than public debt.

But even if attitudes to debt change among the rich countries, it will remain true that many poorer countries cannot raise any further loans. How is that problem to be overcome? It would be a terrible indictment on the world's financial system if could not make the no-sacrifice policy possible. I think this is the only policy that has a chance of overcoming climate change, and it would be terrible if the financial system blocked it. To rise to this challenge, we need a new international financial institution.

It should be modelled on the World Bank, which was initially founded to provide finance to help the world recover from the devastation of the Second World War. The World Bank is owned jointly by the countries that make up its membership. These include countries with large, strong and stable economies, whose financial stability guarantees the Bank's debt. The Bank is able to borrow money on their security, and lend it on to its more needy but less secure members.

We need a World Climate Bank with a similar structure, given stability by the world's most stable economies. It would borrow on the strength of these economies and lend to countries that need to invest in reducing climate change. A feature of these investments is that they take a long time to yield returns; many of the benefits of slowing climate change will not appear for a century. Climate-change investment therefore needs to be financed by very long-

term loans, and the World Climate Bank will have to meet this need. It will be able to do so. The financially secure countries have shown historically that they can support loans of the sort that are needed. They have successfully issued very long-term bonds. Indeed, for two centuries the British government issued ‘consols’, which were infinite-term bonds having no redemption date at all.

I think the international community should divert its efforts away from the appeal to morality towards creating a World Climate Bank. Doing so would make possible a no-sacrifice response to climate change. Adopting this response would be in the interest of everyone in every generation. It would remove the opposition that comes from powerful fossil-fuel interests.

One very serious problem would remain: free riding. Climate change is like the prisoner’s dilemma. A no-sacrifice policy is beneficial to everyone if everyone comes together and adopts it. But it would be beneficial to each country individually not to participate in this policy.

The Australian government knows this well. Free riding is Australia’s official policy. Australia is not reducing its emissions, and the government correctly points out that, if it did, the effect on the Australian climate would be nugatory. Australians will not be directly benefited by reducing Australian emissions. This is because greenhouse gas spreads all around the world and does its harm everywhere. Very little of Australia’s greenhouse gas comes back to hurt Australia. So Australia is hoping everyone else will reduce their emissions while Australia carries on as before.

If the no-sacrifice policy is to be successful, it needs defences against free riding. That is not the subject of this lecture; I do not pretend to solve every problem. All I can say is that some defences are available. For instance, countries that are participating in the policy could set punitive tariff barriers against free riders. Another significant defence may be morality. It would be immoral for Australia to benefit from other countries’ effort to control climate change, but make no effort itself. Even if we do as I recommend and give up the aim of solving the climate-change problem directly by appealing to morality, this role for morality may remain. The great and growing international movements – Extinction Rebellion, Fridays for Future and others – still have a vital role in holding governments to account in this respect. Although I have cynically said that some governments are impervious to morality, I hope that powerful enough public movements might at least prevent them from free riding.

Notes on sources

I owe the leading idea of this article to my one-time PhD supervisor, Duncan Foley. Foley reminded me of the economic theory of externalities, which shows that an externality can be corrected without requiring a sacrifice from anyone. He is also responsible for the idea of a World Climate Bank.

The information reported at the start of this article can be found through google. For instance, google ‘Paris Agreement’, ‘Climate Action Tracker’ (and see specifically https://climateactiontracker.org/countries/australia/), ‘COP 25 Australia’ and ‘Australia bushfires 2019 2020’. Scott Morrison’s remarks are reported on https://www.bbc.co.uk/news/world-australia-50888786. The jubilation at the completion of the Paris Agreement can be seen on https://cdn.theguardian.tv/mainwebsite/2015/12/13/151213Climate_desk.mp4.

Greta Thunberg’s ‘How dare you!’ speech was made to the UN General Assembly. It can be seen on https://www.youtube.com/watch?v=KAJsdgTPJpU and it is printed in her book

No One is Too Small to Make a Difference. The quote from A. C. Pigou is from his *The Economics of Welfare*, Fourth Edition, pp. 29–30.

The standard economic theory of externalities can be found in any textbook on environmental economics. Its extension to intergenerational externalities is in my paper 'Efficiency and future generations', *Economics and Philosophy*, 34 (2018), pp. 221–41, which also explains the standard theory in detail.

Economists who have estimated how much effort should go into dealing with climate change include Nicholas Stern in the *Stern Review: The Economics of Climate Change*, Cambridge University Press, 2007, and William Nordhaus in *A Question of Balance: Weighing Options on Global Warming Policies*, Yale University Press, 2008.

The Koch Brothers' funding of climate denial is described in: https://www.greenpeace.org/usa/global-warming/climate-deniers/koch-industries/.

The idea of a World Climate Bank is developed further by Duncan Foley and me in 'A world climate bank', *Institutions for Future Generations*, edited by Axel Gosseries and Iñigo González-Ricoy, Oxford University Press, 2016, pp. 156–69.