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The Disaggregation of Climate-Induced Harm: An Impossible Undertaking for Utilitarians

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RESUMEN

En este artículo mantengo que los utilitaristas yerran al querer desagregar el daño inducido por el clima, ya sea en términos de causalidad caótica o lineal. Esto no se debe a que las emisiones individuales no cuenten, en términos probabilísticos, para las proyecciones de riesgo de daños climáticos globales, sino más bien a que las emisiones individuales solo contribuyen a aumentar la concentración de CO_2 atmosférico si el flujo del CO_2 antropogénico excede la cantidad de CO_2 que puede ser absorbido naturalmente por la biosfera, en un segmento de tiempo dado. Por lo tanto, sostengo que las obligaciones climáticas individuales consisten en reformar las estructuras sociales y tecnológicas que hacen que cada emisión individual sea parte de un fenómeno colectivo, el calentamiento global, que conduce a una enorme inutilidad global, el cambio climático. En la parte final del artículo, argumento que la ética utilitarista tendría mucho más que decir si, en lugar de concentrarse en la desagregación del daño inducido por el clima, abordara los temas clave de la transición energética, esto es: la fijación del precio del carbono, la investigación y desarrollo de las tecnologías verdes y la financiación climática.

PALABRAS CLAVE: *cambio climático, desagregación, transición energética, obligaciones individuales, utilitarismo*.

ABSTRACT

In this article I hold that utilitarians are wrong to want to disaggregate climate-induced harm, whether in terms of chaotic or linear causality. This is not because individual emissions do not count, in probabilistic terms, for risk projections of overall climate damage, rather because individual emissions only contribute to increasing atmospheric CO_2 concentration if the anthropogenic flow of CO_2 exceeds the amount of CO_2 that can be naturally taken up by the biosphere, over a given time segment. I therefore maintain that individual climate duties consist of reforming the social and technological structures that make each individual emission part of a collective phenomenon, global warming, which leads to an enormous global disutility, climate change. In the final part of the article, I argue that utilitarian ethics would have much more to say if, instead of focusing on the disaggregation of climate-induced harm, it addressed the key issues of the energy transition, i.e. carbon pricing, research and development in green technologies and climate finance.

KEYWORDS: *Climate Change, Disaggregation, Energy Transition, Individual Duties, Utilitarianism.*

INTRODUCTION

Climate change is the result of global warming, which in turn is caused by the accumulation of greenhouse gasses in the atmosphere. The gas contributing most to global warming is CO_2, and its concentration in the atmosphere at the beginning of 2021 has almost doubled compared to pre-industrial levels [278 ppm vs. 417 ppm; see Betts (2021)]. We can simplify by saying that climate change is a function of the amount of CO_2 that accumulates in the atmosphere (and lingers there for hundreds of years) – the higher the amount of CO_2, the more global warming there will be, compared to pre-industrial levels. According to IPCC AR6 (2021), if the world followed a development path based on the indiscriminate exploitation of fossil fuels, as has been the case to date, this would result in global warming of over 4°C above pre-industrial levels by 2100. As an outcome of current climate policies, instead, global warming would be 2.7°C by 2100. This is a far cry from the 1.5°C target (UNFCCC, art.2), which not even all the net-zero targets announced at COP26 (Glasgow 2021), added to those officially submitted and/or already in the process of implementation, would allow to reach – in this more than optimistic scenario, global warming would be 1.8°C by 2100 [C. A. Tracker (2021)]. In order to keep global warming within the 1.5°C threshold, CO_2 emissions must be halved by 2030, and then reduced to net zero by 2050, and the same must be done shortly thereafter with other GHG emissions (IEA 2021, ch. 2; see also Climate Analytics).

Different levels of global warming, again in terms of degrees Celsius, lead to different probabilities in the frequency of climate change-induced harms (CCIHs), which in turn could have devastating effects on both human and non-human species. Consider, for example, the difference between the 1.5°C and 2°C mitigation thresholds. Compared to the 1.5°C target, half a degree of difference (2°C) would bring about the following consequences: the frequency of ice-free summers would increase 10-fold, while the number of people exposed to severe heat waves would rise from 14% to 37% of the world's population, 61 million more people would be exposed to drought in urban areas, 50% more people would face chronic water shortages, and so on [Levin (2018); Buis (2019); see also IPCC (2018), ch.3]. There is no doubt that CCIHs will affect (for worse) the wellbeing of future people and it is also equally clear that CCIHs are already occurring, and it is not difficult to identify the present victims of climate change. Think of the first climate migrants, people who have seen their fields devastated by floods, those who have to cope

with rising food costs, and so on. All these events and phenomena are made more frequent and more destructive by the climate change that has already taken place (global warming is currently 1.2°C above pre-industrial levels).

Yet, a much-debated issue in philosophy is whether individuals are morally responsible for CCIHs, both present and future, every time they perform an action that causes CO_2 emissions. Many philosophers think that individuals are morally blameworthy for emitting CO_2, at least when they are not doing it for subsistence [Hiller (2011); Banks (2013); Nolt (2011)]. The reasoning goes something like this: if the international community is striving to raise the bar on climate mitigation, so as to reduce the climate risks for present and future people as far as possible, it is wrong to take a flight from Milan to Vienna, when you could easily take the train and pollute less – dividing the CO_2 emissions produced by each of the two means of transport (for the Milan-Vienna route) by the expected number of passengers. According to others, however, it is unfair to argue that a single CO_2-generating action is morally wrong, as the amount of CO_2 produced by a single flight (divided per passengers) is so small that, taken in isolation, it causes no harm to anyone. Obviously, this does not mean that individuals should do nothing about climate change, but simply that they should focus on the politics, rather than (simply) individual morality, of climate mitigation [Cripps (2013); Kingston and Sinott-Armstrong (2018); Sardo (2020)]; hence, they should press both national institutions and the international community to undertake all those collective actions that can help reducing emission flows – e.g. investing more in breakthrough green technologies to make them cheaper and more reliable [see Gates (2021); Boehm et al. (2021); Söderholm (2020)].

Those philosophers who embrace this latter position are usually consequentialists, and more precisely act-utilitarians. If the goodness or badness of any action is to be evaluated for its consequences, and if the CO_2 emissions attributable to a single flight (divided per passengers) do not suffice to harm anyone, then we should conclude that we cannot blame any passenger for buying the flight ticket – we can blame her/him, instead, if she/he does not do her/his political part in the ecological transition, e.g. by voting political representative that will not withdraw from the Paris Agreement [Maltais (2013); Sinnott-Armstrong (2005), pp. 303-304].

Nonetheless, some philosophers that are sympathetic with utilitarianism are dissatisfied with the latter conclusion. They consider it unacceptable, if not embarrassing, that a moral theory has nothing to say, in terms of individual morality, about the greatest moral problem of our

time. Thus, they maintain that we can disaggregate every single CCIH into many small individual harms, or more precisely into many (small) individual probabilistic contributions to CCIHs – and so doing they hold people responsible for climate change in their daily actions [Morgan-Knapp and Goodman (2014); Broome (2019); see also Fragnière (2016)]. My argument in this article is that disaggregation does not work, neither with chaotic causality nor with linear causality. And I want to explain why. I conclude by arguing that waiving the disaggregation of CCIH should not unduly upset utilitarians, since the real challenge of climate change will be played out in terms of energy transition and climate finance rather than behavioural changes [see MacLean (2019), p. 4; IEA (2021)]. And on the former issue utilitarians have much to say.

I. Why Collective Climate Harm Cannot Be Disaggregated

The disaggregation argument, in its more general formulation, could be put in these terms: where a final collective harm (FCH) is the result of the sum of several individual contributions (SUM) measurable in units, each unit (U), however small or imperceptible, has its weight, however small or imperceptible, in determining the final harm. Therefore, if we want to understand how much harm a single unit (HU) causes, we could write this simple equation [see Morgan-Knapp and Goodman (2014), p. 181; Hiller (2011), pp. 357-8]:

$$HU = (U/SUM) * FCH$$

The argument is certainly correct in its general formulation, but it does not apply to those cases where a single unit U, analysed in isolation, contributes zero to the SUM. Or to be more precise, in those cases where a single unit U contributes zero to the SUM as long as a certain number of other persons do not produce a certain number of other Us. But this signifies that the value of U, analysed in isolation, is zero, and therefore the equation will also yield zero. I would therefore first like to distinguish between cases where the U value is positive, even if analysed in isolation, and those where it is not, and then focus on the climate issue.

Let us consider this first case. A boy wants to play tennis at the only tennis club he can reach by public transport (let's assume that his parents cannot accompany him). However, he is picked on by all the other boys because he is fat. After every shot he misses, one of the other boys

makes an insulting comment about his size. After two months of incessant insults, the boy can't take it anymore and leaves the club, giving up his passion. None of the insults he received were enough to make him leave the club (otherwise he would not have lasted two months), so it would be unfair to blame a single insulter for the fact that the boy stopped playing tennis. Yet each insult added up to the others, resulting in the great final harm. Here the FCH is given by the boy giving up tennis, and it occurs when a given SUM of insults accumulates, while the single insult is the U. The value of each U is positive. If we conduct an isolated analysis of any insult the boy received, it will tell us how much the single sentence pronounced makes the boy suffer, and this will obviously depend both on the content of the offence and on the subjective perception of the offence. Accordingly, we can calculate how much each insult contributed to the boy's leaving the club through the disaggregation formula.

Let us now consider this second case. Imagine that the demand for houses in the center of a city starts to increase in 2010, peaking in 2021. Landlords follow the law of the market and gradually ask for higher prices. In 2021, the prices are so high that lower-middle-class workers can no longer rent a flat in the city and are compelled move to the suburbs, so they have to make long journeys to work every day.[1] Here we are faced with a series of market transactions (Us) – selling and buying at market price – which, when added together (SUM), result in social injustice, i.e., gentrification (FCH). Every real estate transaction contributes to rising prices, so the causal responsibility for the individual worker not being able to rent a house is not attributable to a specific landlord; it should be distributed, instead, among all the other landlords and tenants (and sellers and buyers) in the city. However, a single market transaction at higher than market prices in 2010 in no way contributes to the overall price increase – for a single transaction to contribute to the gentrification phenomenon, several others must have already set the process in motion.

We could imagine, for example, that in 2005 an exuberant and very rich gentleman comes to the city, where many houses are vacant, and pays for a house twice as much as its market value, for private reasons that there would be no point in discussing. This single transaction would not affect the overall price rise, for the simple reason that the rise has not yet begun – the problem in the city is, rather, an oversupply of housing that drives down prices. If, on the other hand, we assume that this gentleman comes back in 2012, when some economically well-off people have already started looking for houses in the city, thus stimulating house

demand, and he does the same transaction as seven years earlier (i.e. buys a house at twice its market price in 2005), then this action will certainly have an impact on the general price increase induced by an increase in demand – i.e. he will take another house away from those who could have paid less for it.

If we look at the single transaction of this gentleman, U, in 2005 we see that it did not cause any harm to anyone in the city - on the contrary, it certainly benefited the lucky seller. One does not need to do calculations to understand that HU is equal to zero. If, on the other hand, we consider U in 2012, then it is correct to argue that U has an impact on CFH, and thus it makes sense to calculate HU through the disaggregation formula. But what is the difference between 2005 and 2012, such that the value of HU from zero becomes positive? The difference is CFH (raising house demand leading towards gentrification), which in 2005 was absent and in 2012 already began to appear. However, if this is the case, then it means that it is CFH that makes U cause HU, and not the other way around, as disaggregation theorists would have us believe. Obviously, CFH is not "some metaphysically odd emergent entity" [Hiller (2011), p. 349], but is the combined result of the behaviours of the same people causing the Us. And as such it calls for a collective solution rather than an individual one. In other words, it does not make sense to ask the individual buyer to refrain from buying, at market price, the house in the city where she/he wishes to live; we should ask her/him instead to make a political commitment to eliminate, or at least contain, CFH, so that the individual transaction, U, no longer causes harm to anyone, HU – this can be done, for example, by fixing limits for rents, by creating incentives to rent or sell to people on low incomes, by building social housing, and so on.

The climate problem has a similar structure to that of gentrification, rather than the tennis case, and as such it cannot be disaggregated, but only addressed (and hopefully resolved as quickly as possible) by the community. As buying and selling houses at the market price, emitting CO_2 in general, is neither morally good nor morally bad. It is simply the result of a chemical reaction due to production and consumption activities (in the broadest possible sense of the terms). Emitting CO_2 becomes morally bad when it adds up to the stock of CO_2 in the atmosphere. For this to happen, however, it is necessary that in a given time frame t-t1 the carbon cycle is unbalanced, i.e., more CO_2 enters the atmosphere than leaves it (because it is absorbed by plants and oceans, for example). Only then does the single emission U contributes positively to the input-output balance and thus aggravate, albeit in a small and imperceptible

way, the climate problem (CFH). I think that this is clearly put by Augustin Fragnière (2016), p. 801:

> Because of the uptake of carbon dioxide by natural sinks (biomass and oceans), the greenhouse effect is not reinforced until we emit enough CO_2 to overwhelm their absorptive capacity. This critical amount currently represents around 60% of the global emissions, which corresponds to 23 billion tons of CO_2 of the 38 billion humanity emits each year. This means that the first 23 billion tons of carbon dioxide we emit each year do not raise the GHG concentration in the atmosphere – they are below the initial threshold – but also that we overshoot this initial threshold by 15 billion tons of CO_2.

Fragnière refers to IPCC AR5 (2014), p. 4, which says that of all cumulative anthropogenic CO_2 emissions produced between 1750 and 2011, only the 40% remained in the atmosphere, while the rest was stored in plants, soil, and oceans. Along the same lines, also IPCC AR6 (2021), p. 4, tells us that "land and ocean have taken up a near-constant proportion (globally about 56% per year) of CO_2 emissions from human activities over the past six decades, with regional differences". I am not sure that the same proportions can be maintained for a period as short as a year, as Fragnière proposes, and I recognize that this is a very technical subject, which I would certainly not be able to deal with. The point I would like to make, however, is that a significant amount of the CO_2 emitted each year is taken up by the biosphere. Let's assume, for the sake of approximation, that given current emission levels, the amount of CO_2 that gets out of the atmosphere each year through the natural carbon cycle is 50% [see also Kaushik et al. (2020)]. We know that at present we emit about 33GtCO2 (IEA 2021b). This means that, in a given year, for a single emission (U) to contribute to increasing the stock of CO_2 in the atmosphere, the global flow of CO_2 emissions needs to exceed 11.5Gt - if these circumstances are not given, the marginal contribution of U to FCH (i.e., HU) is zero (U neither improves nor worsens the existing climate situation). Let us call it the zero-harm argument.[2]

There are three intuitive objections that could dismantle the zero-harm argument, but I will try to briefly explain that they fail to do so. The first two objections are nicely put by the same Fragnière (2016), p. 801, when he writes:

> […] individuals (as well as firms or nations) might be tempted to say that their personal emissions are below this initial threshold and therefore

> make no difference to climate change. But this argument is unacceptable because they emit in the context of an already too large amount of global GHG emissions, and this fact cannot be brushed aside. Furthermore, scientists have made it clear that the goal is to reach zero CO_2 emissions (and not just to cut them by 40%) by the end of the century.

I would start with the first objection: anyone "emit[s] in the context of an already too large amount of global GHG emissions". Obviously, I do not deny this. We already know that we are going to emit more than 11.5 $GtCO_2$ in any given year (at least until we implement drastic climate mitigation measures), hence it does not make sense to reason about the effects of a single emission, U, in a hypothetical scenario that simply does not exist. But this is exactly the core point of the zero-harm argument. It is because we collectively emit more than 11.5 $GtCO_2$ per year (FCH) that the single emission (U) contributes to increasing the stock of CO_2 in the atmosphere. This means that it is the social-climatic context in which the individual emission (U) takes place that causes the single emission to provoke marginal climate harm (HU) – a social-climatic context, that is, in which anthropogenic emissions exceed the absorption capacity of the biosphere. Conversely, the individual emission can do nothing with respect to the social-climatic context – whether the emission occurs or not, the social-climatic context remains the same [Sinnott-Armstrong (2005)]. Accordingly, there is no point in asking whether the individual emission is morally right or wrong, the question is what moral duties individuals have to reform the social-climatic context that renders any emission harmful.

Then there is the second objection raised by Fragnière against the no-harm argument: "the goal is to reach zero CO_2 emissions (and not just to cut them by 40%) by the end of the century". This is also empirically incontrovertible. When it is said that CO_2 emissions must be made net zero, this does not mean making anthropogenic emissions less than or equal to the emissions that can be absorbed naturally by the biosphere, but rather making anthropogenic emissions less than or equal to so-called negative emissions, i.e., all those CO_2 emissions that are removed from the atmosphere through anthropogenic actions. Once the anthropogenic balance of emissions becomes net zero, the concentration of CO_2 in the atmosphere can then fall, and the earth's average temperature stabilize, thanks in part to the natural carbon cycle, which will reduce the stock of CO_2 instead of counterbalancing the anthropogenic flow [see Hausfather (2021a); IPCC (2018), p. 161]. Negative emissions

can be achieved either by nature-based solutions, for example by enhancing the natural sinks already available in the biosphere, or by technological means, e.g. (CCS) carbon capture and storage and (BECCS) biomass energy with carbon capture and storage [see Haszeldine et al. (2018)[3]. It follows that any individual emission, even if it is absorbable by the biosphere, is an obstacle to effective climate mitigation. A plastic way of looking at this is in relation to the so-called global carbon budget, i.e., the CO_2 emissions that humanity can still afford compatibly with the 1.5°C target – and which are about 360 $GtCO_2$ (for a two/thirds probability) from the beginning of 2021 [Hausfather (2021b); see also IPCC (2021)]. Each individual emission erodes a fraction, albeit infinitesimal, of one of the 360 $GtCO_2$ of the global carbon budget, and thus contributes to the CCIHs to which the progressive depletion of the carbon budget is leading.

All true, but again, it is not the individual emission that leads to a particular CCIH, rather the fact that the emission takes place against a background of contingencies, both past and future, that characterise the social-climatic context. The past contingencies are that almost 2.500 $GtCO_2$ have been emitted since the mid-19th century [IPCC (2021), p. 28]. It is these emissions that determine the size of the carbon budget and thus also its current extreme limitedness. The future contingencies are that we have a reasonable expectation that many more emissions will occur in the next few years, to the point where exhaustion of the carbon budget will be a matter of little more than a decade at the current rate of emissions. Outside of this context, both historical and future, there would be no need to emit less than the biosphere can naturally absorb, as it would be sufficient not to add more CO_2 to the atmosphere to not cause CCIHs. In short, it is true that in the current socio-climatic context every single emission consumes a part of the carbon budget and therefore contributes to causing CCIH, but this is due to all the emissions that have occurred in the past and those that will occur in the future.

A third objection is that even if the above were true, i.e., that responsibility for the CCIH caused by individual emissions lies with the socio-climatic context, emitting CO_2 when one could avoid doing so is tantamount to causing damage that, irrespective of moral responsibility, can be avoided. And this is obviously wrong for any utilitarian. Consider, however, the following case. A defrauds B, bringing him to the brink of economic bankruptcy. C finds himself claiming a legitimate debt from B. C is very rich and does not need the money he would get from B, and also knows that if he collects his debt, he will cause an irreversible financial collapse for B. However, C goes ahead and gets the debt paid. B is

ruined. Was C's action moral? No, on a general principle of beneficence. Can C be said to have caused financial harm to B? No: if A had not defrauded B, C's claim would not have caused B any problem. Similarly, a person engaging in avoidable emission-generating activity is failing in a moral duty of beneficence, but she/he cannot be held morally responsible for CCIH.

II. Climate Harm and Chaotic Causality

When we discuss whether climate harms can be disaggregated, we should distinguish between relations of chaotic causality, such as those linking the increase in atmospheric CO_2 concentration with the intensification of anomalous climatic events – e.g., hurricanes, heatwaves, droughts, floods – and relations of more linear causality, such as those between the increase in the Earth's average temperature and the rise in sea level due to melting glaciers. In this second part of the article, I intend to explain how my argument against the disaggregation of climate harm applies to both chaotic and linear causality relations. I start with the former.

When we say that an increase in the concentration of CO_2 in the atmosphere raises the probability of anomalous atmospheric events we mean a number of things: (i) that the CO_2 variable is part of a series of other meteorological variables that determine these atmospheric phenomena; (ii) that there is a directly proportional relation between atmospheric CO_2 concentration and the frequency of anomalous atmospheric events; (iii) that this directly proportional relation can only be expressed in probabilistic terms (i.e. we cannot establish that N ppm of CO_2 will cause N hurricanes in the time frame t1-t2, but we can establish the probability that the frequency of a given type of anomalous weather event will vary if the CO_2 concentration in the atmosphere also varies from N ppm to N1 ppm). We also know that the emissions caused by a single action such as a flight from Milan to Vienna are not sufficient to cause a change in the frequency of any atmospheric event, and therefore apparently cause no harm to anyone.

There is, however, a very clever objection to this argument that was recently put forward by John Broome. According to Broome (2019), p. 119, the function of CCIH is not linear but instead proceeds by "jumps". He says:

> If the total of everyone's emissions were not in the middle of a level stretch of the graph, but were instead just before a jump, then increasing your emissions would do harm because it would trigger the jump. If the total of emissions were just beyond a jump, reducing your emissions would do good.

What Broome means is that it is wrong to imagine emissions as a sequence of harmless little pieces that add up together without causing damage, until the whole chain of pieces causes a great deal of damage in the end (a mutation in the frequency of anomalous atmospheric phenomena). Instead, Broome says, it is fairer to take into account the fact that any small amount of CO_2 can cause a jump in the damage function, i.e., cause an additional anomalous weather phenomenon (e.g., a hurricane, a flood). Obviously, it is impossible to know if and which action will generate the additional emissions needed to cause the jump in the harm function, but the simple fact of knowing that it could be you who perform this action means that potentially every action that generates CO_2 could stand in a causal relation with a harm suffered by someone (e.g., a child dying in another country due to a major hurricane). This is a moral reason enough to minimise your ecological footprint.

A similar argument is also made by Morgan-Knapp and Goodman (2015), p. 184:

> […] your decision to take a recreational drive may set off what is sometimes called the "butterfly effect" […] There is some very small but non-zero probability that the scenario in which you do not drive features a hurricane season next year that contains three hurricanes, whereas the scenario in which you do drive features four hurricanes.

One easy way to respond to the "jump" argument is that even if you refrain from emitting the quantity of CO_2 emissions that cause the jump, in the same fraction of a second, billions of other people around the world will emit the same amount of CO_2 needed to make the jump. Thus your "sacrifice" will have been in vain. One could respond, however, that there are infinite jumps, so no matter what anyone else does, there is always a risk that your emissions, however small, will cause harm to someone. Therefore, in deciding whether to emit or not, you have to take into account the risk, however small, of causing an enormous disutility to someone else. The certain, minimal utility you get from the single polluting action may therefore be lower than the disutility, weighted for the risk factor, of the jump in the harm function. If this were the case,

then act-utilitarianism would have its say in terms of individual climate morality.

Broome (2019), p. 121, argues in this way:

> You are inevitably ignorant: you cannot know whether or not total emissions are just before a jump […] This is what matters for whether or not you ought to joyguzzle. It is independent of the behaviour of other people that Sunday; it is very nearly constant. Because of this, you can correctly treat the rest of the world as a force of nature, not as a group of strategic agents interacting with you.

The problem with Broome's reasoning, in my view, is that a single N amount of CO_2 cannot cause any jump in the harm function for the reason I outlined above: there is a margin of about 11.5 gigatons of CO_2 being annually absorbed natural carbon sinks (and which could clearly increase if cheaper and more practical CO_2 sequestration technologies were developed and/or by expanding existing natural carbon sinks). If we had a reasonable expectation that in a calendar year humanity would not exceed this overall emission threshold, any CO_2 emitted would not add to the accumulation of CO_2 in the atmosphere, because the total balance (emissions minus absorption/sequestration) would be negative, or at most zero. The same would be true if we reached the global target of net-zero emissions in the coming decades. Imagine a rapid and effective transition to renewable energies and the introduction of new CO_2 sequestration technologies. The few CO_2 we would continue to emit would not accumulate in the atmosphere, because it would be either absorbed or seized, and thus the action that before the net-zero scenario caused, according to Broome, a jump in the damage function would no longer produce it (on this, I think Broome would also agree).

Again, it could be argued that given current contingencies we know both that we are still far from the net-zero scenario and that we do not yet have necessary technologies available to achieve it [IEA (2021), p. 96], so it is clear that every action that causes CO_2 emissions contributes to the accumulation of CO_2 in the atmosphere, thus increasing the function of climate harm, and can determine the famous jump. This is empirically incontrovertible, yet my point is that this is not due to the individual action, rather to the social circumstances in which the action takes place. And this makes, in my view, every CCIH a problem of collective coordination, consisting of regulating the uncoordinated actions of a huge multitude of people, rather than an issue of individual morality. That is, Broome is wrong, in my opinion, when he says that "you can

correctly treat the rest of the world as a force of nature, not as a group of strategic agents interacting with you". The circumstance that your single action may cause harm to someone, based on the "jump" argument, has social origins, and is therefore subject to change – it is not correct to treat it as an immutable background fact.

III. Climate Harm and Linear Causality

There are, however, some cases in which the causal link between increased CO_2 concentration and CCIHs proceeds in a much more linear pattern. Let's think, for example, of the relation that exists between global warming and sea-level rise [Stips et al. (2016)]. Sea-level rise is mainly due to melting glaciers and the expansion of water volume due to temperature increase. If we calculate how much a single quantity X of CO_2 contributes, in probabilistic terms, to the rise in the earth's average temperature within a fixed timeframe (e.g. by 2100), and if we also calculate the impact that the increase of each fraction of a degree Celsius has on the rate of melting of glaciers and expansion of the volume of water, then we could disaggregate the harm that a single CO_2 emission causes through marginally contributing to melting glaciers and water expansion- and thus also the harm that people suffer as a result of the rise of each centimetre in sea level. Morgan-Knapp and Goodman (2015), p. 187, make a very good argument about this. They start with an important premise:

> There is a very finely graded spectrum of greenhouse gas concentrations in the atmosphere that starts from the concentrations there would be if emissions stopped right now and ends with the concentrations sufficient to cause our Bangladeshi terrible suffering.

And they run a thought experiment in which they ask us to imagine a future Bangladeshi that will be severely hit by CCIHs. They ask us to consider "how she would feel under a randomly chosen greenhouse gas concentration on our spectrum". Obviously, they perfectly know that the future Bangladeshi cannot experience any difference between a scenario in which a randomly chosen person living now emits more or less CO_2. Yet, they say, "if the Bangladeshi would suffer terribly from the accumulation of many subtle effects of climate change caused by future emissions, then she must feel much worse under the concentrations at the

end point than at the beginning point […] Consequently, at least some point (and probably many points), the Bangladeshi really can feel the difference that the emissions produced by a recreational drive makes. The claim that no one will feel such differences would be false" [Morgan-Knapp and Goodman (2015), p. 187].

Let's try to elaborate this case further and imagine that there is a level L of sea level rise above which the Bangladeshi person starts to suffer from CCHIs (e.g., due to floods destroying houses and agricultural activities) – the higher the sea rise compared to L, the higher the floods, the more CCIHs. If we consider a spectrum of sea level rise L-L30 (where 30 are centimeters), we could say that the Bangladeshi is not indifferent to any variation L-L30, since any centimeter of sea-level rise will make water more dangerous. If we also associate a probability with the effect that each variation in global warming in the 1.5°C-3°C spectrum has on sea level rise, then we can come up with a function that indicates the impact that each individual emission-generating action has on sea level rise. And according to the reasoning of Morgan-Knapp and Goodman, there will exist various threshold points, corresponding to changes in sea levels, to which the Bangladeshi is not indifferent. Therefore, following a reasoning similar to Broome's argument on chaotic causality, even in linear causality the risk that you may be the one to cross the threshold point of non-indifference for the Bangladeshi should lead you to minimise your emissions.

My objection to the disaggregation of CCHI due to linear causation is the same as with chaotic causation: the causal effect of a single action causing X emissions is nil, but not because it is not felt by anyone, rather because it contributes nil to the accumulation of CO_2 in the atmosphere, at least as long as anthropogenic emissions are less than can be offset by the carbon cycle. If we consider the points of non-indifference with respect to the spectrum L-L30 of sea-level change (which in turn is related to changes in the global warming spectrum of 1.5°C-3°C), it is certainly true what Morgan-Knapp and Goodman say: L30 is much worse than L, so there will be several Ln points ($L<Ln<L30$) which, if exceeded, will cause perceptible increase in damage to the Bangladeshi. From this, however, it cannot be inferred that the moral responsibility for crossing any such threshold Ln lies with the one who causes the last marginal increase in CO_2. For if other people had not carried out a series of similar actions in the same time frame (e.g., the calendar year), the last marginal increase in CO_2 would not have been sufficient to get from Ln_{+1} to Ln_{+2}.

IV. Act-Utilitarianism and Energy Transition

My impression is that the debate on the disaggregation of CCIH started at a time when it was not yet clear what effort we would have to make to mitigate climate change (we started discussing these issues well before the global target was set at 1.5°C) and when we did not yet have the technologies available to us at today's prices. What I mean to say is that the climate mitigation challenge is so daunting – going from 33GtCO_2 today to net zero in less than 30 years – that individual frugality (fewer flights, less meat, fewer cars) is certainly a good thing, but by no means sufficient to meet the climate mitigation challenge.

As the International Energy Agency (2021), p. 17, recently noted with respect to the threshold of net-zero CO_2 emissions by 2050:

> We estimate that around 55% of the cumulative emissions reductions in the pathway are linked to consumer choices such as purchasing an EV, retrofitting a house with energy-efficient technologies or installing a heat pump. Behavioural changes, particularly in advanced economies – such as replacing car trips with walking, cycling or public transport, or foregoing a long-haul flight – also provide around 4% of the cumulative emissions reductions.

On the one hand, we have a global population that will probably reach 10 billion by the end of the century. And developing countries that will fill the gap with more developed countries, with a proportional increase in demand for energy, meat, cars, and so on. On the other hand, we have realised with the Covid-19 pandemic that keeping people at home helps to reduce emissions, but by very little. If in 2020, when most of the world has gone through more or less long lockdown periods, CO_2 emissions fell by only 5%, what would it take to get an additional 95% reduction? And even if we could answer that question by a stretch of the imagination, any attempt to implement such a thing would lead to global economic collapse [see Gates (2021) p. 13].

There is only one way to save the earth from irreversible climate change: make renewable energy sources more accessible and more reliable - e.g. by lowering the cost and improving the performance of electric batteries and/or finding biofuels for those vehicles, such as aircraft, on which it is unthinkable to install batteries – [see Lamperti et a. (2019); Söderholm (2020); Tian et al. (2022)], and increase the market price of fossil fuels so as to bring it as close as possible to the social cost [Metcalf (2019); Helm (2020); Gajevic Sayegh (2019); Mintz-Woo (2021)]. Only if

this happens will we really succeed in substantially reducing emissions. Behavioural changes alone count for very little – at least those of ordinary people. We should not convince people to travel less, we need, instead, to develop the cheap technologies needed for pollution-free travel and get people to buy them. To this end, there is little point in discussing whether individual travel is morally right or wrong. There are, instead, a number of systemic issues on which utilitarians could focus their analysis.

The first issue is certainly carbon pricing. Given the current climate contingencies, every CO_2 ton has a social cost, indicating the economic damage it generates in the future [see Fleurbaey et al. (2019)]. Fossil fuels are strong on the market because their price does not include the social cost. Those who bear the social cost of CO_2 are usually the most vulnerable, both domestically and internationally. Those who externalise the largest share of the global social cost of CO_2 are the largest energy consumers, i.e. the richest. Introducing policy measures that require emitters to internalise the social cost of CO_2 means redistributing wealth from the very well off to the very poor. This objective is obviously at the heart of utilitarian ethics, and it also fits in well with the cosmopolitan approach that utilitarians take.

The second issue concerns the management of financial resources, both public and private, in the crucial phase of the energy transition. There is a desperate need for a broad deployment of renewable energies, both to mitigate climate change and to offset the inevitable rise in fossil fuel prices. The benefits of any marginal improvement in renewables technology are enormous, if we take into account the CCIHs they help to avoid and the savings in energy costs, the effect of which is obviously greatest on the poorest people [see Roser (2020); UNEP (2016); IEA (2020); Luciani (2020)]. Yet many resources are spent on activities that produce much smaller marginal increases in utility [see also Boehm et al. (2021)]. The classic utilitarian argument raised in the past with respect to global poverty thus returns here. If you have a lot of money, and plan to spend it on futile purchases, you have a moral duty to transfer this money, at least in part, to those who could use it to satisfy basic needs, and in some cases for simple survival [see Singer (2009)]. The same could be said today about climate change. If it is true that uncontrolled global warming threatens to collapse the economies of many developing countries, especially those in Asia, within thirty years [Swiss Re Institute (2021)], research and development in clean technologies must be at the forefront of public and private investment programmes.

The third issue is loss and damage. The earth is already 1.2°C warmer than it was before the industrial revolution, and the negative effects of climate change are there for all to see. Within the developed world, it is the poorest people, who have the least capacity to adapt to heat, to atypical weather patterns and to fires, who suffer the most. Globally, on the other hand, the main victims of climate change are developing countries, both because they are poorer, because they often start from already high temperatures and because they rely more on agriculture, which is one of the productive sectors most vulnerable to climate change [see Pidcock and Yeo (2017); Page and Heyward (2017)]. Both domestically and globally, there are some very wealthy people who suffer less from the negative effects of climate change, and who could alleviate the plight of those who are not only poorer but also face the greatest loss and damage from climate change. A utilitarian does not need to disaggregate the environmental damage of the former to justify a redistribution of resources towards the latter; it is sufficient to resort to the concept of diminishing marginal utility. The means to do this is climate finance, i.e., the transfer of funds, both public and private, to developing countries [see Timperley (2021)]. The transfer can take place either in the form of a grant or a loan, although it is easy to see that the grant option is more in line with utilitarian ethics, especially if the donor is much richer than the beneficiary, and can be directed either to adaptation projects or to dealing directly with loss and damage.

To understand the grip that utilitarian ethics can have on the issue of climate finance, it is useful to quote a recent op-ed by Jeffrey Sachs (2021): "[developing countries] see rich countries spending an extra $20 trillion or so on their own economies in response to COVID-19, but then failing to honor their promise – dating from COP15 in 2009 – to mobilize a meager $100 billion per year for climate action in developing countries".

CONCLUSIONS

In this article I maintained that climate change-induced harm (CCIH) cannot be disaggregated. I took into consideration the general formula for disaggregating of collective harm, HU = (U/SUM) * FCH, where HU is individual harm, FCH is final collective harm, SUM is the sum of actions causing FCH, and U is the single divisible unit of SUM. I explained why the formula cannot be applied to CCIH. When the carbon

cycle is balanced (the CO_2 entering the atmosphere in a given time segment is less than or equal to the CO_2 leaving it), FCH is zero and hence also HU is zero. FCH, instead, becomes positive, thus also making HU positive, when the carbon cycle is unbalanced. But this means that it is FCH that makes U positive or negative, so it is FCH that causes HU, and not the other way around.

In the second part I argued that the impossibility for utilitarians to disaggregate climate damage does not mean that utilitarianism has nothing to say in terms of climate justice; far from it. An ecological transition that is both effective and equitable inevitably involves a range of economic policies that shift resources away from the consumption of unnecessary, or at least non-primary, goods and services, towards protecting the interests of the most fragile, both domestically and globally. The three main issues of climate transition, namely carbon pricing, research and development in green technologies, and finance for adaptation and loss and damage, lend themselves to a strong utilitarian moral critique of the current status quo. A small minority of people are stubbornly holding back a huge amount of resources, both public and private, that could be used to considerably increase global aggregate utility in the coming decades. Utilitarianism still has a great deal to teach us about this.

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NOTES

[1] This case is a re-elaboration of the famous example of the structural injustice in the house market discussed by Iris Marion Young (2011), pp. 43-52.

[2] For a further formulation of the argument and a complementary analysis see Corvino and Pirni (forthcoming).

[3] In addition, there are also more complex geo-engineering solutions, such as direct air capture (DAC) or stratospheric aerosol injection [see also Gardiner (2020)].

REFERENCES

BANKS, M. (2013), 'Individual Responsibility for Climate Change', *Southern Journal of Philosophy*, vol. 51, no. 1, pp. 42-66. *https://doi.org/10.1111/sjp.12008*

BETTS, R. (2021) 'Atmospheric CO_2 Now Hitting 50% Higher than Pre-industrial Levels', *CarbonBrief*, March 16. *https://www.carbonbrief.org/met-office-atmospheric-co2-now-hitting-50-higher-than-pre-industrial-levels*

BOEHM, S., K. LEBLING, K. LEVIN, H. FEKETE, R. WAITE, A. GEIGES, A. NILSSON, R. WILSON, J. THWAITES, J. JAEGER and D. PLECHATY. (2021), 'We're Not on Track for 1.5 Degrees C. What Will it Take?', *World Resources Institute*, October 28. *https://www.wri.org/insights/climate-action-progress-indicators-2030-2050-targets*

BROOME, J. (2019), 'Against Denialism', *The Monist*, vol. 102, no. 1, pp. 110–129. *https://doi.org/10.1093/monist/ony024*

BUIS, A. (2019), 'A Degree of Concern: Why Global Temperatures Matter', *NASA*. *https://climate.nasa.gov/news/2865/a-degree-of-concern-why-global-temperatures-matter/*

CLIMATE ANALYTICS, 'Understanding the Paris Agreement's Long Term Temperature Goal'. *https://climateanalytics.org/briefings/understanding-the-paris-agreements-long-term-temperature-goal/*

CORVINO, F., A. PIRNI (forthcoming), 'L'Etica del Cambiamento Climatico alla Prova dell'Inefficacia Causale Individuale: Discutendo la Libertà Collettiva di Emissione di Gas Serra Rispetto all'Obiettivo di 1.5°C', *Rivista di Estetica*.

CRIPPS, E. (2013), *Climate Change and the Moral Agent: Individual Duties in an Interdependent World*, Oxford, Oxford University Press.

FRAGNIÈRE, A. (2016), 'Climate change and Individual Duties', *WIREs Climate Change*, vol. 7, no. 6, pp. 798–814. *https://doi.org/10.1002/wcc.422*

GAJEVIC SAYEGH, A. (2019), 'Pricing Carbon for Climate Justice', *Ethics, Policy & Environment*, vol. 22, no. 2, pp. 109-130. *https://doi.org/10.1080/21550085. 2019. 1625532*

GARDINER, S. M. (2020), 'Ethics and Geoengineering: An Overview', in L. Valera and J. C. Castilla (eds.), *Global Changes: Ethics, Politics and Environment in the Contemporary Technological World*, Berlin, Springer Verlag, pp. 69-78.

GATES, B. (2021), *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need*, London/New York, Allen Lane

HASZELDINE R. S., F. STEPHANIE, J. GARETH and S. VIVIAN (2018), 'Negative Emissions Technologies and Carbon Capture and Storage to Achieve the Paris Agreement Commitments', *Philosophical Transactions of the Royal Society A*, 376: 2016044720160447. *http://doi.org/10.1098/rsta.2016.0447*

HAUSFATHER, Z. (2021a), 'Will global Warming 'Stop' As Soon As Net-Zero Emissions are Reached?', *Carbon Brief*, April 29. *https://www.carbonbrief.org/explainer-will-global-warming-stop-as-soon-as-net-zero-emissions-are-reached*

— (2021b), 'Analysis: What the New IPCC Report Says About When World May Pass 1.5C and 2C', *Carbon Brief*, August 10.

https://www.carbonbrief.org/analysis-what-the-new-ipcc-report-says-about-when-world-may-pass-1-5c-and-2c

HILLER, A. (2011), 'Climate Change and Individual Responsibility', *The Monist*, vol. 94, no. 3, pp. 349–368. *https://doi.org/10.5840/monist201194318*

IEA (2020), *Innovation in Batteries and Electricity Storage: A global analysis based on patent data. https://www.actu-environnement.com/media/pdf/news-36144-etude-oeb-batteries-brevets.pdf*

— (2021). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. Retrieved from: *https://iea.blob.core.windows.net/assets/448cac7-edd6-4c03-b6a2-8e79792d16d9/NetZeroby2050-ARoadmapfortheGlobalEnergySector.pdf*

IPCC (2021), 'Summary for Policymakers', in *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. In Press. *https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf*

— (2014), 'Summary for Policymakers', in *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/ 2018/06/ AR5_SYR_FINAL_SPM.pdf*

— (2018), *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. https://www.ipcc.ch/sr15/*

KAUSHIK, A. J. GRAHAM, K. DORHEIM, R. KRAMER, J. WANG and B. BYRNE (2020), 'The Future of the Carbon Cycle in a Changing Climate', *Eos*, February 20. *https://eos.org/features/the-future-of-the-carbon-cycle-in-a-changing-climate*

KINGSTON, E. and SINNOTT-ARMSTRONG, W. (2018), 'What's Wrong with Joyguzzling?', *Ethical Theory and Moral Practice*, vol. 21, no. 1, pp. 169-186. *https://doi.org/10.1007/s10677-017-9859-1*

LAMPERTI, F, M. MAZZUCATO, A. ROVENTINI and G. SEMIENIUK (2019), 'The Green Transition: Public Policy, Finance, and the Role of the State', *Vierteljahrshefte zur Wirtschaftsforschung*, vol. 88, no. 2, pp. 73-88. *https://www.econstor.eu/bitstream/10419/225183/1/10_3790_vjh_88_2_073.pdf*

LEVIN, K. (2018), 'Half a Degree and a World Apart: The Difference in Climate Impacts Between 1.5°C and 2°C of Warming', *World Resources Institute*, October 7. *https://www.wri.org/insights/half-degree-and-world-apart-difference-climate-impacts-between-15c-and-2c-warming*

LUCIANI, G. (2020), 'The Impacts of the Energy Transition on Growth and Income Distribution', in M. Hafner and S. Tagliapietra (eds.), *The Geopolitics of the Global Energy Transition*, Cham, Springer, pp. 305-318. *https://doi.org/10.1007/978-3-030-39066-2_13*

MACLEAN, D. (2019), 'Climate Complicity and Individual Accountability', *The Monist*, vol. 102, no. 1, pp. 1–21. *https://doi.org/10.1093/monist/ony019*

MALTAIS, A. (2013), 'Radically Non-Ideal Climate Politics and the Obligation to at Least Vote Green', *Environmental Values*, vol. 22, no. 5, pp. 589–608. *http://dx.doi.org/10.3197/096327113X13745164553798*

MINTZ-WOO, K. (2021), 'Will Carbon Taxes Help Address Climate Change?', *Les ateliers de l'éthique / The Ethics Forum*, vol. 16, no. 1, pp. 57-67.

MORGAN-KNAPP, C. and GOODMAN, C. (2015), 'Consequentialism, Climate Harm and Individual Obligations', *Ethical Theory and Moral Practice*, vol. 18, pp. 177–190. *https://doi.org/10.1007/s10677-014-9517-9*

NOLT, J. (2011), 'How Harmful Are the Average American's Greenhouse Gas Emissions?', *Ethics, Policy & Environment*, vol. 14, no. 1, pp. 3-10. *https://doi.org/10.1080/21550085.2011.561584*

PAGE, E. A. and C. HEYWARD (2017), 'Compensating for Climate Change Loss and Damage', *Political Studies* vol. 65, no. 2, pp. 356–372.

PIDCOCK R. and S. YEO (2017), 'Explainer: Dealing with the 'Loss and Damage' Caused by Climate Change', *Carbon Brief*, May 9. *https://www.carbonbrief.org/explainer-dealing-with-the-loss-and-damage-caused-by-climate-change*

ROSER, M. (2020), 'Why Did Renewables Become So Cheap So Fast?', *Our World in Data*, December 1. *https://ourworldindata.org/cheap-renewables-growth*

SACHS, J. (2021), 'Fixing Climate Finance', *Project Syndicate*, November 15. *https://www.project-syndicate.org/commentary/fixing-climate-finance-requires-global-rules-by-jeffrey-d-sachs-2021-11*

SARDO, M.C. (2020), 'Responsibility for Climate Justice: Political Not Moral', *European Journal of Political Theory*, online first: 1-25. *https://doi.org/10.1177/1474885120955148*

SINGER, P. (2009), *The Life You Can Save: Acting Now to Stop World Poverty*, New York, Random House.

SINNOTT-ARMSTRONG, W. (2005), 'It's Not My Fault: Global Warming and Individual Moral Obligations', in W. Sinnott-Armstrong and R. Howarth (eds.), *Perspectives on Climate Change*, Amsterdam, Elsevier, pp. 285-307.

SÖDERHOLM, P. (2020), 'The Green Economy Transition: The Challenges of Technological Change for Sustainability, *Sustainable Earth*, vol. 3, no. 6, pp. 1-11. *https://doi.org/10.1186/s42055-020-00029-y*

STIPS, A., MACIAS, D., COUGHLAN, C., GARCIA-GORRIZ, E., and SAN LIANG, X. (2016), 'On the Causal Structure Between CO_2 and Global Temperature', *Scientific Reports*, vol. 6 (21691), pp. 1-9. *https://doi.org/10.1038/srep21691*

SWISS RE INSTITUTE (2021), *The Economics of Climate Change: No Action Not an Option. https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-economics-of-climate-change.html*

TIAN, J., L. YU, R. XUE, S. ZHUANG and Y. SHAN (2022). 'Global Low-Carbon Energy Transition in the Post-COVID-19 Era', *Applied Energy*, vol. 307 (118205), pp. 1-11. *https://doi.org/10.1016/j.apenergy.2021.118205*

TIMPERLEY, J. (2021), "How to Fix the Broken Promises of Climate Finance", *Nature*, 598: 400-402. *https://doi.org/10.1038/d41586-021-02846-3*

TRACKER, C. A. (2021), *Warming Projections Global Update. November 2021. https://climateactiontracker.org/documents/997/CAT_2021-11-09_Briefing_Global-Update_Glasgow2030CredibilityGap.pdf*

UNEP (2016), *Green Energy Choices: The Benefits, Risks and Trade-Offs of Low-Carbon Technologies for Electricity Production. https://www.resourcepanel.org/reports/green-energy-choices-benefits-risks-and-trade-offs-low-carbon-technologies-electricity*

UNFCCC (2015), *Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf*

YOUNG, I. M. (2011), *Responsibility for Justice*, Oxford, Oxford University Press.