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Rita Tatiana Vasconcellos Lopes d'Oliveira
Bouman

An Ethical Approach to Sustainability Research: Contributions to Methods and Strategies

NTNU
Norwegian University of Science and Technology
Thesis for the Degree of
Philosophiae Doctor
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Department of Philosophy and Religious Studies



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Abstract

This thesis aims at mitigating some of the most common moral tensions in different discourses, methods, strategies, and actions in sustainable development. The methods used to accomplish these goals are the identification of moral content and relevant values in sustainable development discourses and practices, while demonstrating their potential role in strengthening sustainability. This thesis includes the application of the identified ethical principles and values in the development of sustainable development methodologies and policies.

Firstly, the thesis focusses on climate change as an example of a sustainable development challenge where moral tensions and values play a significant role in both the scientific and the policy discourse and practices, while the second part is dedicated to the application of previously identified ethical principles and values to specific multidimensional policies (Sustainable Development Goals) and scientific methods (footprint).

In this thesis, I argue that across the great variety of agents, discourses, and practices in sustainable development, it is possible to distinguish common values and ethical principles. However, I affirm that this can function as a(n) (additional) barrier to the design of strategies and implementation of actions without a careful analysis of potential unwanted (e.g. justice, environmental, social) effects. One way to mitigate this adverse effect is to open moral argumentation and validation of sustainable development initiatives to less dominant values and principles, such as human capacities and functionings.

Another moral challenge in the sustainable development arena is to ensure that practices integrate justice safeguards. My research indicates that the interest of future people (mainly distant generations) is not sufficiently considered in international policy documents (Sustainable Development Goals), and ethicists should help fill in the gaps towards more justice-oriented policies, as proposed by the inclusion of additional sufficientarian targets to the existing ones. Similarly, popular scientific sustainable development methods (footprints) have justice shortcomings that can be improved if they are re-designed to integrate justice dimensions as I propose via the *just footprint*. In my understanding, doing so broadens and strengthens science evidence-based policies and hopefully mitigates (environmental and social) injustice.

Ensuring sustainable human development requires revisiting specific ethical theories, and developing new concepts that acknowledge relevant scientific findings. Accordingly, and in direct response to the strong sustainability paradigm and the planetary boundaries, I propose

the inclusion of *irreplaceable goods* in the intergenerational justice debate to single out the criticality of certain (environmental and social) goods for reaching sufficient levels of well-being, capabilities and/or rights. Hopefully, the introduction and use of this concept can facilitate the applicability of fairness principles to practical policy contexts.

Overall, in this work, I call for broadening of the scope of applied ethics to enhance its analytic power to deal with the moral problems of sustainability, and ultimately, to consider sustainability ethics as a special branch of applied ethics.

With this dissertation, I aim at reinforcing the notion of a need for co-creation of knowledge in the field of sustainable development as a means of harmonising discourses and actions and ultimately lowering the barriers to its widespread implementation. Still, more research should be performed on the moral nature of sustainable development as a means of achieving sustainability.

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Rita Tatiana Vasconcellos Lopes d'Oliveira Bouman

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Errata

p. 16: 'in tonnes of carbon dioxide equivalents' should be read in 'billion tonnes of carbon dioxide equivalents'.

p. 51: '*Journal of Social Sciences Naresuan University, 14(1), 14_163-191*' should be read '*Journal of Social Sciences Naresuan University, 14(1), 163-191*'.

p. 51: '*Journal of Applied Ethics, (2), 141-170*' should be read '*Journal of Applied Ethics, 2, 141-170*'.

p. 82: '*Critical Social Work, 11(3)*' should be read '*Critical Social Work, 11(3), 68-81*'.

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Notes on the Articles

The present thesis is the product of research in applied ethics with an interdisciplinary approach to the subject of sustainability. The thesis is composed of five articles, as follows:

Article 1- The potential of Co-benefits in Climate Change Mitigation Strategy: An opportunity for Environmental and Social justice. Published in the Journal of Social Sciences, Naresuan University, vol.14, n° 1 in 2018.

Article 2- Ethical implications of a co-benefits rationale within climate change mitigation strategy. Published in the journal *Etikk i praksis*, Nordic Journal of Applied Ethics, vol.2 in 2016.

Article 3- Back to the Future: The Potential of Intergenerational Justice for the Achievement of the Sustainable Development Goals. Published in the journal *Sustainability*, vol.10 in 2018.

Article 4- A Methodological Framework for Developing More Just Footprints: The Contribution of Footprints to Environmental Policies and Justice Goals. Published in the journal *Science and Engineering Ethics*, in 2019.

Article 5- Justice with a Future: Contributions from Sustainability to Intergenerational Sufficiency. In preparation for publication in 2021.

List of Acronyms

CA- Capability approach

CCM- Climate change mitigation

CO₂- Carbon dioxide

GHG- Greenhouse gases

EEIO- Environmentally extended input-output analysis

IPCC- Intergovernmental Panel on Climate Change

LCA- Life-cycle assessment

REDD⁺- Reducing Emissions from Deforestation and Forest Degradation Mechanism

RQ(s)- Research question(s)

SD- Sustainable development

SDGs- Sustainable development goals

UN- United Nations

UNEP- United Nations Environment Programme

WHO- World Health Organization

Introduction to the Concepts of Sustainability and Sustainable Development

In recent years, sustainability has become a key concept worldwide. Nevertheless, the omnipresence of this theme in everyday discourse does not make it more understood or less contentious. This thesis is a small contribution to the elucidation of this subject from an ethical viewpoint.

Traditionally, sustainability was associated with viable practices in forestry and animal management, which can be traced to the ancient civilisations (Vasconcelos Oliveira, 2011). In a form closer to our common understanding, sustainability began during the modern ages. At the time, it related to *unsustainable* practices, mostly related to colonialism. With the Enlightenment came a certain degree of scientific development, a criticism of unrestrained urbanism, and a more intense desire for harmony with nature. These factors helped to shape ideas that contributed to a new attitude towards the human relation to nature. The work of Rousseau is a good example of the rising sentiment of disapproval about the social and moral status quo and the search for alternatives based on nature. (Caradonna, 2014). The 18th century was a milestone for sustainability because the concept was laid down as a principle in the German forestry industry (Spindler, 2013; Wiersum, 1995). As Jeremy Caradonna writes, ‘there was no explicit sustainability movement (or even environmental movement) in the eighteenth-century Western world. [...] But at the very least [deforestation] was beginning to be seen as a serious problem by some’ (Caradonna, 2014, p. 27). Interestingly, the notion of sustainability was not used only in the context of management or even in Germany. It developed in the wider context of European culture, which dictated that philosophical and ethical dimensions were included in this notion (Jenkins & Schröder, 2013).

The initial steps towards the shift from sustainability as a concept to a movement happened much later. The shift started in the 1960s, with Carson’s book *Silent Spring* (Carson, 1962) and continued until the 1990s. In 1972, the Club of Rome published the influential work *Of The Limits To Growth*, where the most novel idea was the necessity of creating a world system capable of supporting human life (Meadows, Meadows, Randers, & Behrens III, 1972). This came to be the embryo for our present understanding of sustainability.

The leapfrog for sustainability came with its acknowledgement by the United Nations (UN) in the 1980s through the famous Brundtland report (World Commission on Environment and

Development & Brundtland, 1987). *Our Common Future* has the additional importance of enshrining the moral foundation of sustainability. This report was the first political document to interpret sustainability as sustainable development (SD), and more importantly, it justified SD through moral arguments, based on the interests of future generations.

Commonly, sustainability refers to a harmonious state of the human civilisation in relation to the elements of the biosphere (closer to an ecological definition), while SD refers to the human strategies or the type of societal development that ensures sustainability (Castro, 2004). Sustainability requires the balanced pursuit (through SD) of (at least) three aims: an ecological dynamic equilibrium, social equity, and economic welfare. It is grounded on the ethical commitment to the well-being of both contemporary individuals and future people. Unsurprisingly, the history of sustainable development discourse is originally anthropocentric, in the sense of (only) valuing the needs of human beings, for example, related to the negative consequences of unrestrained urbanism on human health (Caradonna, 2014). The moral consideration of other environmental elements, especially dissociated from religious beliefs, only appears much later in sustainability discourse (Vasconcellos Oliveira, 2011) and is still rare in SD today (Boscardin & Bossert, 2015).

Despite the simplified descriptions of sustainability and SD above, these are in essence concepts with multiple interpretations (Mebratu, 1998). This factor adding to the complexity of the Earth system and the enormous shifts in thinking and acting it proposes makes sustainability difficult to address and SD inherently demanding to implement. Other difficulties derive from the development and implementation of new technologies since they (may) have potentially negative consequences for people and the planet. Another challenge comes from the requirement of a multidisciplinary procedure to conceive sustainability and implement SD.

A striking example of all these challenges coming together was the 2015 United Nations Sustainable Development Summit. This event gathered world political leaders, scientists and civil organisations to address the challenges of concerted global action. In this summit, the UN adopted the sustainable development goals (SDGs), which should be achieved by 2030 as elements of a decisive plan, Agenda 2030 for collective action towards the materialisation of SD (United Nations, 2015).

The SDGs place greater demands on society, institutions and the research community than did the Millennium Development Goals, which they replaced. According to Fukuda-Parr,

(2016, p. 44), the SDGs had a different purpose and conception. The political process that drove their elaboration was also distinct: the SDGs did not set a ‘North-South aid agenda’ but rather created a road map to sustainable development.

They address climate change, renewable energy, food, health, and water provision among other SD challenges. SDGs are an outline of (17) aims, strategies and (169) targets (United Nations, 2016) to achieve more well-being and a sustainable future. They aim to adequately respond to the global challenges facing our civilisation, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice (United Nations Economic and Social Council, 2017).

The international events and policy documents resulting from the SDGs ultimately lead to several unsolved tensions concerning conflicting visions and approaches to SD complex issues. These strains are already evident in the enunciation of the SDGs, as many people regard them as unequally important. Recent work by Messerli et al. (2019), devoted to the challenges of implementing SD, points out the need for understanding better the trade-offs and synergies between SDGs in policymaking, while addressing the co-benefits and conflicting objectives of the SDGs. Characteristics of SD such as systems thinking, dissimilar research fields, and many actors (Bouwen & Taillieu, 2004) with conflicting paradigms (Westing, 1996) create additional obstacles that prevent and complicate common reflection and action.

Scientific data shows the urgency of a vigorous response to environmental challenges (UN Environment, 2019). As Steffen et al. (2015) write, it is necessary to implement SD that is within the safe operating space of planetary natural boundaries. Such accomplishment requires fast detection of possible tensions between the several agents and institutions to harmonise discourses and actions. Among these sources of tensions, there are hidden and often contradictory ethical frameworks and values (Jamieson, 1998; Jenkins, 2013; Struik, Kuyper, Brussaard, & Leeuwis, 2014; Turner & Pearce, 1993). Within SD discourse, there are different frameworks that can justify values in contradiction to values justified by other frameworks. As an illustration, SD includes several paradigms such as the recent ‘carbon neutrality paradigm’ and the 1970s’ ‘resource scarcity paradigm’ (Turner & Pearce, 1993). These are different prioritisation frameworks for implementation of SD measures that conflict regarding the merit of bioenergy deployment, due to its potential negative effects in soil availability and quality. On one side of the ‘carbon neutrality paradigm,’ there are values like biodiversity and

efficiency, while the ‘resource scarcity paradigm’ includes food security and the rights of underprivileged populations. In practical circumstances, they are known to be a source of dispute (Arevalo, Ochieng, Mola-Yudego, & Gritten, 2014; Söderberg & Eckerberg, 2013).

This situation dictates the urgency and relevance of ethically analysing sustainability and SD and of developing a mature body of philosophical work dedicated to them. My thesis aims at contributing to this need by bringing to light relevant moral problems and dilemmas and subjecting sustainability to ethical analysis to help in facilitating understanding and implementation of what we need to do to support a fair sustainable society.

Sustainability as subject of Applied Ethics

Sustainability is a key concept in the era we live in – Anthropocene. It promotes a counterpoint to the deep transformations the human being has inflicted to the environment. In this sense, sustainability is the perfect subject for examination in applied ethics.

Applied ethics considers particular ethical concerns, in private and public life, and sustainability is part of a particular domain of societal concerns. Since sustainability is related to specific situations, problems, and practices (SD) that arise within the spheres of the environment, society and economics, the ethical analysis of sustainability would come under the category of ‘practical ethics’. Lurie supports such a possibility by alluding to the fact that ‘since the ethical situations discussed in applied ethics promote a way of understanding the ethical ramifications of these situations, they are part of an interpretive and critical discourse of both ethics and life situations. [...] Applied ethics does not limit itself to just binary questions of right or wrong, good or bad, just or unjust; rather, it discusses the ways in which certain practices and social situations are ethically meaningful’ (Lurie, 2018, p. 475). This is the case for SD and sustainability, as they integrate actions and situations deserving of consideration in moral terms.

In all the different ways sustainability is understood, and particularly interpreted as SD, there is an inherent moral dimension that concerns the good and right way to act within parameters that safeguard the environment. In this sense, the moral nature of sustainability is independent of the particular definition of SD, as it always integrates some kind of formulation of a ‘correct’ or ‘adequate’ form of human development (orientational aspect). SD translates into (individual

and collective) practices and situations oriented by what ought to be done to achieve a certain eco-socio-economic status (evaluative and normative dimensions).

If we consider sustainability as a goal that guides a wide variety of personal and collective choices concerning the environment, society and economics, its moral dimension is self-evident. The moral nature of sustainability is also clear when used as a synonym of SD. The Brundtland report described SD as ‘meeting the needs of the present without compromising the ability of future generations to meet their needs’ (United Nations, 1987), which stresses the responsibility of contemporary society for the well-being of both present and future generations. This call for responsibility derives from the ethical tradition of rights, obligations, and flourishing of the human being.

Sustainability and SD controversies are good examples of the decisive role of applied ethics in the framing and the design of potential solutions for the problems created by uncontrolled human development. Problems such as climate change and the loss of biodiversity are not challenges that just require scientific understanding. Knowing about the causes or effects of such phenomena is part of a more extensive effort to find valid solutions. Strategies to solve or mitigate complex problems such as the ones previously mentioned tend to be multiple and with relevant trade-offs. For example, increasing the percentage of wind in the energy mix is potentially an effective way to decrease GHG emissions. Research findings support eolic energy as a safer alternative to the combustion of fossil fuels (Wiedmann et al., 2011). However, there are limitations to an extensive deployment of this technology in terms of its negative impact on the bird population (Drewitt & Langston, 2006). Facing the dilemma of whether to invest in this technology requires questioning if it is the ‘right’ thing to do. This particular interrogation is no longer the domain of science but of applied ethics.

The relevance of sustainability as a particular subject of broader reflection in applied ethics increases as philosophers realise that traditional and narrower focus of environmental ethics does not respond to the emerging questions and moral dilemmas that sustainability creates. The main focus of traditional environmental ethics is on our relationship to nature and its valuative properties (see for example Brennan & Lo, 2015)¹. Such scope does not offer (all) the necessary

¹ This refers to the distinction between the comparative scope and focus of applied ethics and environmental ethics, and the need for a broader analysis. The point is solely about the need to broaden the traditional focus of applied ethics to enhance analytic power so is sufficient to solve the ethical problems of sustainability. By no means should it be interpreted as a statement that applied ethics is ‘better suited’ than environmental ethics for this task. The point here is merely to state the need to broaden the scope of analysis of applied ethics.

theoretical responses needed to the questions around sustainability, particularly for SD. In other words, environmental ethics falls short in considering the social and economic elements from a moral viewpoint as well as the emerging interactions among them and the environmental element. To support this assertion, the example of eolic energy will be used again. In the case of the deployment of wind turbines, specific ethical dilemmas arise, for example, related to animal welfare (Agnew, Smith, & Fowkes, 2016) or to the value of biodiversity (the negative effect of wind farms on certain bird populations) (Heuck et al., 2019) that can be analysed in environmental ethics. However, the ethical analysis of, for example, the energy co-benefits of wind energy would not be addressed by environmental ethics and yet, it is crucial to consider this point when morally characterising eolic energy. Undoubtedly, there are overlapping areas between environmental concerns and sustainability. Nevertheless, I would still argue that sustainability as an object of moral reflection goes beyond the biotic and abiotic environment and integrates social and economic dimensions, which give rise to different moral problems and situations. Consequently, I maintain that sustainability and its implementation (SD) should be addressed in an independent branch of applied ethics. In this sense, this thesis is a small contribution to the emancipation of sustainability ethics, because the emphasis is on themes that have clear environmental facets but involve other elements derived from the sustainability phenomenon. A clear example of the wider scope that certain themes require from a moral point of view is the SDGs, especially in terms of their implementation. Traditionally, questions of prioritisation and discussion about the diminished capacity of achieving to the fullest equally important SD targets (trade-offs) are not part of environmental ethics scope and could, therefore, be left out of the moral analysis. Simply put, society evolves and increases complexity, which demands renewed commitment from ethicists to critical analysis of society, entailing the necessary emergence of new fields of moral knowledge.

In more general terms, sustainability's three-dimensional constitution creates what Becker (2011) calls moral sustainability relations: among humans and their contemporaries, between humans and future generations and humans and the environment. These different relations require more than the existing ethical theories and a potentially straightforward application to sustainability issues; they entail the need to develop a specific new type of ethics dedicated to 'integrated analysing of the ethical aspects of the threefold embeddedness of human beings in the sustainability relations' (Becker, 2011), 19.

Climate Change: A moral issue

One of the most relevant issues in SD, and in particular in the SDGs, is climate change. The relevance of climate change rests on the dependence of the biosphere, and especially of human civilisation, on a stable climate. Consequently, climate change became the ‘umbrella’ for other environmental challenges we are facing.

Climate change can be defined as the change in global weather patterns most significantly felt from the 1950s. Earth’s geology shows that the climate has changed considerably throughout time due to natural processes. Nevertheless, in the last half century, the changes have become far more intense and faster than any period in geohistory (Lewis & Maslin, 2015). The consensus is that it is extremely likely that human activity has been the dominant cause of the rapid warming (United Nations Intergovernmental Panel on Climate Change - IPCC) and that climate change poses significant challenges to our way of life on Earth (IPCC, Intergovernmental Panel on Climate Change, 2018a).

The accumulation of greenhouse gases (GHG) causes global warming and disrupts the natural balance of the atmosphere, increasing the heat-trapping layer that warms the Earth’s surface (land and sea). Gases are easily distributed through large-scale atmospheric circulation, so heat-trapping affects the whole planet. This phenomenon is global warming and it is the major driving factor in human-caused climate change (IPCC, Intergovernmental Panel on Climate Change, 2014). One of the contributing factors is the increase in human population. Population growth is sustained by the surge in industrialisation, agricultural development, and deforestation, in addition to a strong increment in fossil fuel use. As IPCC, Intergovernmental Panel on Climate Change (2000) reminds us, human activity releases far more GHG and at a much faster rate than natural processes.

In response to climate change, substantial efforts are being made to reduce or prevent GHG emissions, i.e. climate change mitigation (CCM). They involve reductions in human (anthropogenic) emissions of GHG and at the same time an increase in the capacity of carbon sinks, for example via intense afforestation.

Under current projections, concentrations of GHG will continue to contribute to global warming. World GHG emissions have roughly doubled since the early 1970s (Schmalensee, Stoker, & Judson, 1998), and even under the current policies, global per capita GHG emissions

have increased by 13.4% from 2000 to 2015 (Crippa et al., 2019). In terms of a global carbon budget (input of CO₂ carbon dioxide- to the atmosphere minus the storage in the carbon reservoirs), there is a positive and increasing trend.

The figure below shows the evolution of global warming in relation to the Paris Agreement of keeping global temperatures below an increase of 2°C. The figure includes different scenarios of emissions to reach this CCM target (IPCC, Intergovernmental Panel on Climate Change, 2018b).

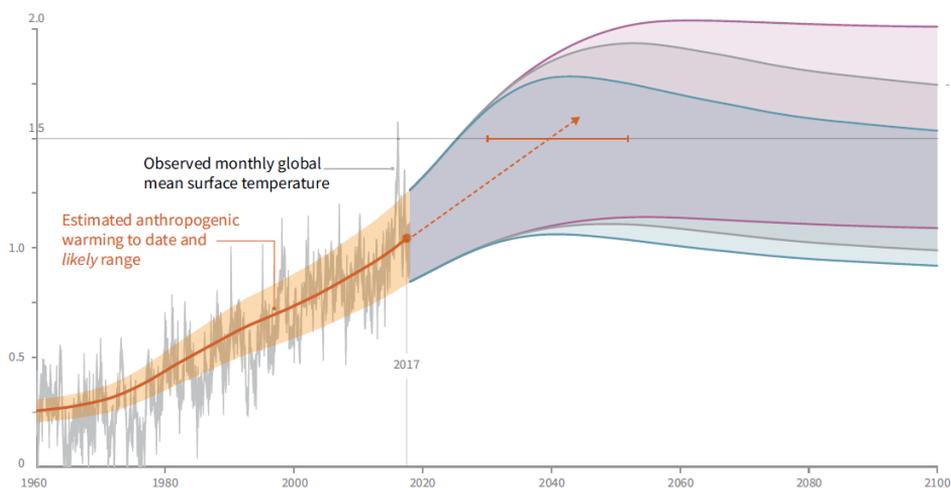


Figure 1- Observed global temperature change and modelled response to stylised anthropogenic emission and forcing pathways. Observed monthly global mean surface temperature change and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading). The orange dashed arrow and horizontal orange error bar show respectively the central estimate and likely range of the time at which 1.5°C will be reached if the current rate of warming continues. The grey plume shows the likely range of warming responses, computed with a simple climate model, to a stylised pathway (hypothetical future) in which net CO₂ emissions decline in a straight line from 2020 to reach net zero in 2055 and net non-CO₂ radiative forcing increases to 2030 and then declines. The blue plume shows the response to faster CO₂ emissions reductions reaching net zero in 2040, reducing cumulative CO₂ emissions. The purple plume shows the response to net CO₂ emissions declining to zero in 2055, with net non-CO₂ forcing remaining constant after 2030. Adapted from IPCC (2018b, p. 6).

Figure 1 shows that even before reaching an increase of 2°C in global temperature, the present climate situation demands immediate and concerted action. There is clear evidence that severe negative impacts are being felt by millions of the most vulnerable individuals and marginalised communities (United Nations, 2019). Climate change affects all people but not homogeneously. The poor and most vulnerable individuals are the ones to suffer the worst effects (Gardiner, 2004). Figure 1 also shows how different current paths of human development will affect the average global temperature change in the near and more distant future. These differences in average temperature change make evident how our present socio-economic development will directly impact climate for future generations. In essence, human-caused climate change that unjustly affects the most vulnerable individuals in the world predominates. This situation is a moral problem that requires an ethical approach to climate change action if the objective of SD is to achieve environmental justice in general, and more particularly, to alleviate climate injustice.

Figure 2 shows the different options to tackle climate change. They are mitigation, geoengineering and adaptation.

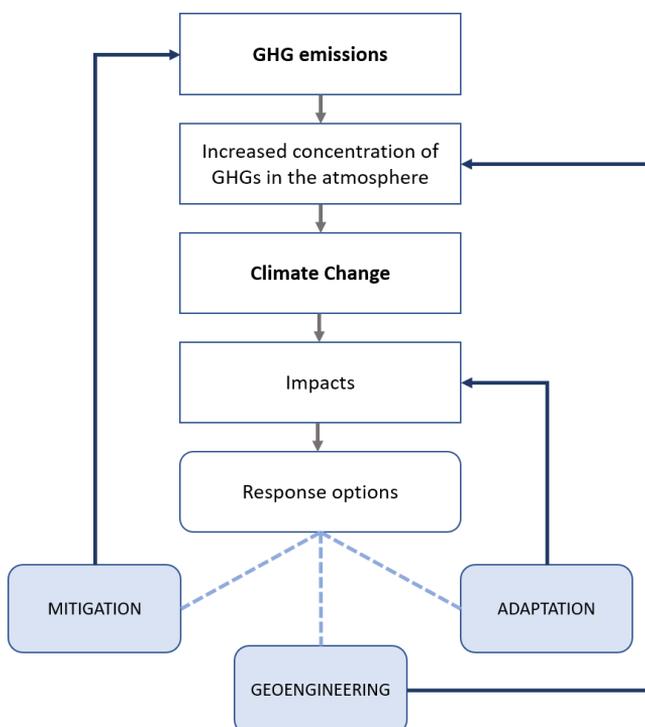


Figure 2- Representation of the three types of strategies to address global warming. Climate change mitigation focuses on implementing actions at the level of the anthropogenic GHG emissions, by decreasing them. Climate adaptation aims at increasing the resilience and diminishing the negative impact of climate change. Geoengineering mainly aims at decreasing the effect of GHG emissions by technological solutions. Adapted from Tietenberg & Lewis (2015, p. 640).

Figure 2 shows that each type of strategy targets the phenomenon at a different stage. Each climate change action is associated with different scientific and ethical challenges precisely because of this fact. The scope of this thesis includes only mitigation and adaptation strategies.

When considering the types of strategies to tackle climate change, it is relevant to understand that the benefits of decisive and early action on mitigation may be more important and less costly than those of adaptation. This is particularly evident in the case of loss of biodiversity due to climate change, which can be considerably reduced through early and stringent mitigation (Warren et al., 2013). Nevertheless, with the current GHG emissions trend, both types of strategies must be carried out, even for safeguarding biodiversity. The cost and trade-offs in adaptation scenarios are far more significant than for mitigation (Felton et al., 2016), since actions take place to reduce the impact of (relevant) lost ecosystem services.

More importantly, CCM would prevent climate injustice in developing countries in the case of these nations not being properly helped to adjust to the new environmental conditions (Michaelowa, 2001). Besides, there is the possibility of creating additional advantages for the environment, the economy, and mostly for people if CCM strategies such as the decarbonisation of the economy are implemented (Smith, 2013; Ürge-Vorsatz, Novikova, & Sharmina, 2009).

Co-benefits are exactly these advantageous outcomes of CCM, i.e. mitigation efforts can have positive side effects due to the intersection with other societal goals. Co-benefits do not include the direct benefits of climate policy arising from a more stable climate, but rather the eco-socio-economic advantages that emerge from implementing specific CCM actions. One of the clearer examples is air quality. The combustion of fossil fuels generates GHG, which cause global warming and air pollution. Tackling climate change by decreasing fossil fuel use will have the extra benefit of cutting emissions of soot, acidic gases, ozone-forming gases and toxic compounds that cause problems including heart and lung diseases and cancer, saving the life and health of millions of people.

Co-benefits of climate change mitigation can also include local economic value creation, new employment opportunities, access to affordable energy, and urban and rural development. They can function as an incentive for governments to implement sustainable, climate-friendly policies.

Following the same trend as SD, for example in the field of environmental management, (Beckmann, Hielscher, & Pies, 2014; Du Pisani, 2006; Fischer et al., 2015; Stafford-Smith et al., 2017; Voltan, Hervieux, & Mills, 2017), co-benefits are increasingly considered in a more integrative way (Sovacool, Martiskainen, Hook, & Baker, 2020), which makes the case for CCM action far stronger, especially regarding public acceptance. Moreover, scientific evidence as presented, for example, in the Global Sustainable Development Report of 2019 suggests that change towards achieving the SDGs offers many opportunities for reinforcing rather than inhibiting itself (Independent Group of Scientists appointed by the Secretary-General, 2019). The main reason is that there are many co-benefits to be gained from the implementation of SDGs, and they surpass in relevance the associated trade-offs (Independent Group of Scientists appointed by the Secretary-General, 2019, p. 6). However, there is a need to research more the interlinkages between the SDGs, because the understanding of these connections is still far too little. This is also vital to stimulate (and potentially re-direct) co-benefits and handle trade-offs better. This also implies that not enough attention has been given to examine cross-sectional phenomena in the past, despite the efforts of SD triple bottom line focus and life-cycle assessment- LCA methodology.

Despite the synergies between CCM and some policy initiatives in other sustainability areas, like pollution reduction, there is no perfect alignment between them. Furthermore, the existence of these positive synergies does not eliminate relevant and difficult trade-offs and diverging objectives. To boost co-benefits, positive societal influence requires a multidisciplinary rationale in CCM action. One of the most usual barriers to this integrative CCM strategy is overlooking the moral implications of these actions. This thesis aims to increase the influence of ethical reasoning in CCM strategising through the development of concepts and policy suggestions based on the ethical tradition.

Another important aspect of climate change is the necessary quantification of the emissions, especially concerning their allocation to activities or services. It is imperative to know who emits GHG and how much. For such accounting, there are well-established measures and

scientific tools. Still, despite a wide application of these tools and measures, they are not without (scientific and moral) limitations.

Figure 3 shows the global distribution of total GHG emissions trend by economic sector. It is interesting to observe that despite the climate treaties, total GHG emissions associated with key human activities such as energy production or transportation have not decreased in recent years. This evidence points to the (at least partial) failure of SD strategies.

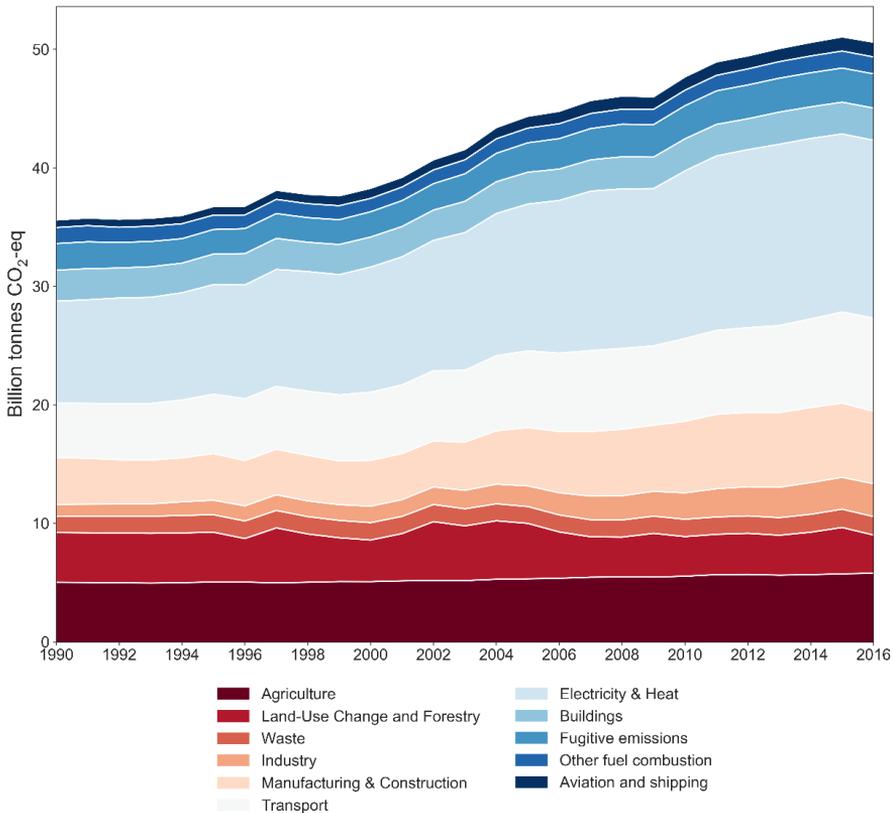


Figure 3- World GHG emissions by sector. Breakdown of total GHG emissions in tonnes of carbon dioxide equivalents. Adapted from Ritchie & Roser (2019).

Figure 4 shows global CO₂ emissions by region and income. In the first part of the figure, it is possible to see the relation between national income level and carbon emissions. It illustrates the relative emission contributions from parts of the world with different economic development levels. Currently, 16% of the world population (the wealthiest) are responsible for 38% of the global emissions per year. This demonstrates the disproportional responsibility for

the negative consequences of climate change of a small fraction of the human population. The second part of the figure makes evident the great weight of the ‘developed’ north in climate change in the per capita emissions of CO₂. Both figures are testimonies of the (environmental) inequality generated by the present socio-economic development and demonstrate the urgency of implementing SD actions that guarantee fair(er) transitions.

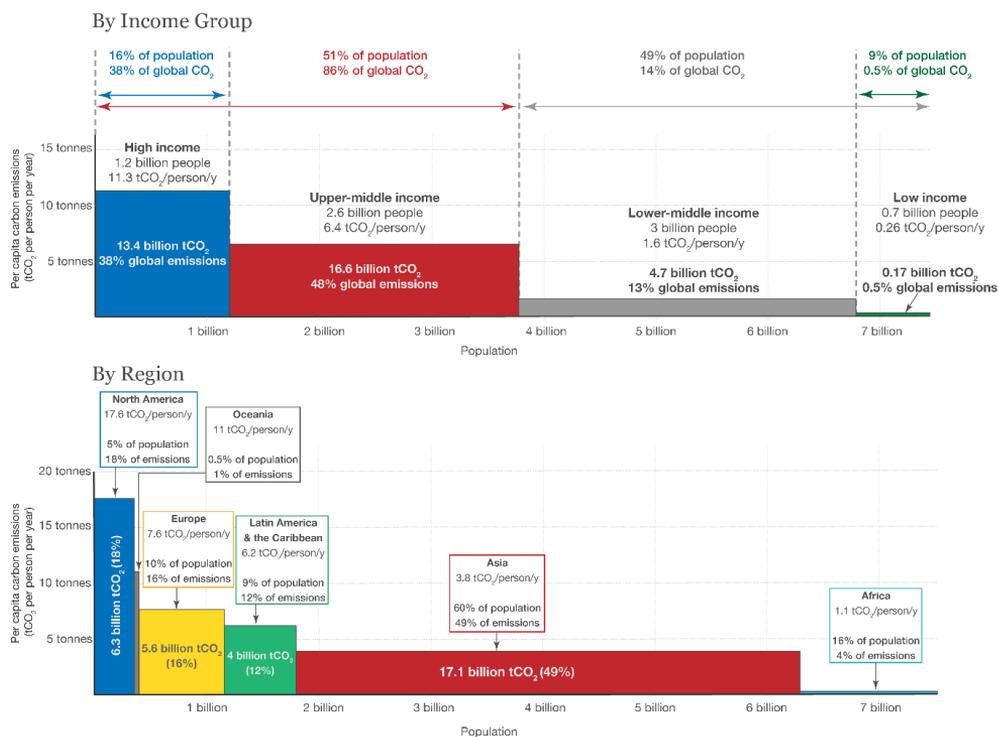


Figure 4- Global CO₂ emissions by income group (top) and region (bottom) for 2016. The results are based on average per capita emissions (y-axis) and population size (x-axis), with the area of the box representing the total emissions. These emissions are domestic and do not include cross-boundary emissions (e.g. shipping, aviation). Source: Ritchie & Roser (2019).

SD at large and CCM strategies, in particular, rely on information about emissions (e.g. trends, totals) and emitters (e.g. sectors, agents) to be successful. Identifying and determining the scale of emissions is the key step in formulating and assessing SD and CCM strategies, especially when it is necessary to reach the target of the 2°C, included in the Paris climate agreement (United Nations Framework Convention on Climate Change, 2018).

Figure 5 below shows the carbon emission trends necessary to accomplish carbon neutrality in either 2040 (grey line) or 2050 (blue line). Scientists argue that reaching climate neutrality is absolutely crucial for climate stability. Fig. 5 a) illustrates how urgent it is to act so to reach carbon neutrality sooner rather than later. Fig. 5 b) testifies to how little ‘carbon’ we can still emit (CO₂ budget) to reach carbon neutrality in either 2040 (grey line) or 2050 (blue line). Figs. 1, 4 and 5 provide supporting evidence for immediate and resolute SD action (current generation). They both show how current developmental (in-)action will impact proximal and distant future generations. In this sense, they emphasise the ethical nature (e.g. justice and rightness) of society’s stand and actions on climate change.

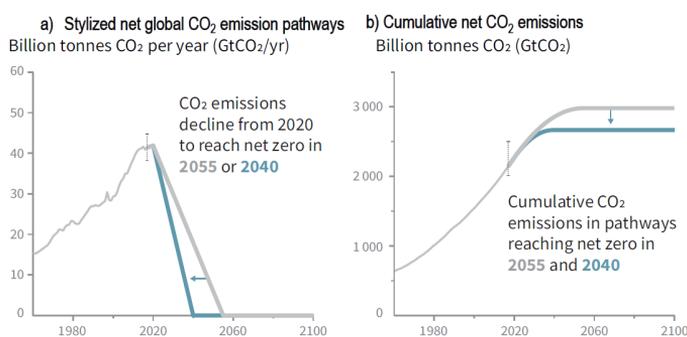


Figure 5- a) Net global CO₂ emissions pathways (hypothetical futures) in which net CO₂ emissions (grey line) decline in a straight line from 2020 to reach net zero in 2055 and a response to faster CO₂ emissions reductions (blue line) to reach net zero in 2040. b) Cumulative net CO₂ emissions in both scenarios. The difference between the grey and blue lines in the stationary phase gives an estimate of the carbon budget left for (proximal and distant) generations. Source: IPCC, Intergovernmental Panel on Climate Change (2018b, p.6).

This requirement includes what Mohai, Pellow, and Roberts (2009, p. 406) designate as environmental justice. According to these authors, environmental justice ‘emerged as an interdisciplinary body of literature, in which researchers were documenting the unequal impacts of environmental pollution on different social classes and racial/ethnic groups. Today, hundreds of studies conclude that, in general, ethnic minorities, indigenous persons, people of colour, and low-income communities confront a higher burden of environmental exposure from air, water, and soil pollution from industrialization, militarization, and consumer practices’.

In sum, the moral dimensions of SD go beyond the traditional ethical domains, which motivate this thesis to consider sustainability as a phenomenon that requires the description and analysis of its concepts and principles at least in three spheres: the social, economic, and environmental domains. It becomes essential to unveil the ethical tensions and dilemmas in social, economic and environmental practices, actions and policies in the SD context, which are frequently regarded as morally neutral. The other part of the ethical work required to analyse sustainability is normative. This goal can be achieved by analysing, defending, proposing and applying normative concepts and principles to sustainability as a paradigm and SD as a means to achieve it. The current thesis covers both these requirements.

Hypothesis and Research Questions

From the early beginning of the thesis drafting, it was clear that moral (and scientific) tensions existed within SD discourse and praxis. It seemed that (at least partially) the variety of agents involved, competing conceptualisations of SD, limited analytic tools and unsatisfactory implementation strategies were contributing factors to this effect. These suppositions need to be investigated systematically to understand the underlying foundations and dynamics of such strains. Still, the increasing societal acceptance and implementation of SD seen the last decades was an indicator that, at least to some extent, such tensions could be mitigated.

Having these reflections as a backdrop, my research hypothesis is that despite SD's heterogenicity there are shared moral positionings and values, which have the potential to facilitate dialogue and common action if there is a careful analysis of their implications. The general claim is the following: there is need, in SD discourses and practices, of (a more) systematic examination and reflection on the implications of the imbedded moral frameworks, principles and values, especially because they might be creating or supporting unwanted outcomes which, ultimately can jeopardise the environment and (present and future) human well-being.

Hence, the general purpose of the thesis is to inform ethically SD, by identifying the moral content and relevant values of some of SD discourses and practices, while demonstrating their potential role in the strengthening of sustainability. The starting point of this research is the analysis of diverse sustainability discourses, methods, actions and strategies used in the implementation of SD. The work extends to singling out standpoints and values, as well as ethical implications, in SD discourse and praxis. The final research phase included the application of those ethical principles and values in the development of SD methodologies and policies.

In the scientific discourse, as well as in policy documents, sustainability is framed by a moral background that needs to be clear to allow a fruitful reflection. With this thesis, I wanted to understand which (could be) is/are the common moral denominator(s) and what can be their implications, to what extent the moral framework affects the SD discourse and praxis, as well as its appropriateness, and how to develop SD methodologies with clear moral standards.

More precisely, the thesis aims to (1) uncover shared and/or (potential) conflicting moral frameworks, principles and values integrated SD discourses and practices, (2) reflect on their (ethical and environmental) implications, and (3) critically analyse and expand the contribution of applied ethics for the design and implementation of SD. Accordingly, the detailed research questions (RQs) are the following:

RQ I: What frequently contributes to moral tensions and dilemmas in SD discourses and practices and why?

RQ II: What are some of the relevant commonly found moral frameworks, principles and values in SD discourses and practices?

RQ III: What are the implications of shared (and/or potentially absent) ethical frameworks and principles in SD discourses and practices, especially in the facilitation of SD implementation?

RQ IV: What are common consequences of conflicting and/or competing moral frameworks, principles and values in SD discourses and practices?

RQ V: How can applied ethics contribute and shape SD discourses and practices?

To answer these questions, I first focus on the issue of climate change as an example of an SD challenge where moral tensions and values play a significant role in both the scientific and the policy discourse and praxis. The last part of the thesis is not based on specific environmental policies but rather targets multidimensional SD policies (SDGs) and scientific methods (footprint).

Theoretical Framework

On the path to Sustainability Ethics: The potential of traditional Moral Philosophy

The thousands of years of philosophical tradition offer an invaluable acquis of theories and concepts that are at the disposal of ethicists and scientists. At first glance, the myriad of available approaches might seem inadequate for the ethical reflection of a concept that is as recent as sustainability. However, these theories hold relevant keys on how to approach this kind of subject and most importantly, they can be the basis of new moral frameworks. As Becker (2011, p. 21) suggests, to deal with ethical questions of sustainability and sustainable development, it is good to continue using the insights of traditional moral philosophy and recent ethics.

In the case of my work, both deontological and consequentialist moral traditions were used as benchmarks for ethical analysis of sustainability and SD discourses, strategies, and methods. The justification for the use of fundamental approaches for the construction of ethical systems lies in their normative and prescriptive natures. Deontological and consequentialist moral theories offer general, abstract principles which open the possibility for logical exploration in relation to action.

One of the most relevant ethical tensions in SD discourses, strategies and methods (as in other fields) is the potential non-distinction and interchangeability between *good* and *right*.

The analysis of the interpretation and use of *good* and *right* in contextualised examples originated from the necessity to address the value of justice. This task required an approach that was theoretically different from deontology and consequentialism. In that sense, and still (partially) addressing the relationship between *good* and *right* but now framed under a paradigm coincidental with SD's core ideal - human well-being - the capability approach (CA) will be used from here on was integrated into the theoretical toolbox of the thesis.

Justice in the context of SD could be approached in different ways. The choice was guided by specific SD discourses, implemented policies and methods (e.g. in CCM). Their analysis brought to light two critical dimensions: distributive and procedural justice.

In the context of SD, the work of Rawls on justice is very influential and has shaped discourses and practices for years, especially in connection to the distributive aspects (Jabbari,

Motlagh, Ashrafi, & Abdoli, 2020; Holden, Linnerud, & Banister, 2017; Henderson, 2011). In the famous book *Theory of Justice*, Rawls offers other relevant insights but now on procedural matters. His distinction of three types of procedural justice (perfect, imperfect and pure procedural justice) (Rawls, 1999) seemed relevant to the analysis of one of the iconic SD methodologies – footprints – mainly because of its (potential and effective) role in the processes that are used to determine how benefits and burdens are allocated to people.

Besides (Rawlsian) egalitarianism, sufficientarianism is a benchmark in the thesis. Both make it possible to address the distributional aspects of SD in the policy context. Article 3 is an example of the application of both theories in the policy context of the UN goals for sustainable development.

Despite recognising that there are limits to all of the previously mentioned theories and that new approaches may be needed where the old ones do not offer proper framing, I strongly believe that ‘traditional’ applied ethics can offer precious help when creating the moral conceptual body of sustainability and SD. In that sense, in this thesis, new concepts and interpretations (e.g. ‘irreplaceable goods’ in article 5) were proposed so as to align and respond more adequately to the specificities of the topic.

‘Good’ and ‘Right’: The influence of Utilitarianism and Deontology in Sustainability Ethics

The application of the utilitarian ethical approach to SD has been long, and in many cases fruitful, especially when in connection with economics (Hampicke, 2011) and public policy (Dietz & Asheim, 2012). However, the influence may not always be clear and easily perceptible; neither is it usually made explicit by the SD agents. In this respect, and considering the thesis desideratum of contributing to a better understanding of the ethical implications of SD, it was fundamental to test if this is indeed the case, while understanding to what extent this influence exists and the implications of such weight.

Articles 1 and 2 show the utilitarian influence in concrete SD discourses, practices and policy documents (for more details, see the section *Scientific methods in SD studies*). This influence plus the overall general importance of the utilitarianism in SD (Campagna, Guevara, & Le Boeuf, 2017; Dietz & Asheim, 2012; O’Hara, 1998) dictated that it would become one of the theoretical pillars of the entire work.

The analysis of international scientific reports (e.g. IPCC, UNEP, WHO reports), SD flag projects (e.g. REDD+- Reducing Emissions from Deforestation and forest Degradation mechanism) and SD policy documents (e.g. the Hasselt mobility programme) on co-benefits from CCM showed the prevalence of certain utilitarian principles mainly related to welfarism and consequentialism as well as aggregation and maximisation.

Not surprisingly, the notion of well-being was a recurrent theme in the discourses, practices and strategies analysed in articles 1 and 2. In those cases, well-being corresponds to utility in the sense of (human) welfare or advancing towards good, somehow similar to what Bentham defines as utility, which includes *benefit*, *advantage* and even to a certain degree, *pleasure* (Bentham, 1789).

In the context of SD, (preference-satisfaction) utilitarianism is a popular concept mainly because we are currently living in the (economic) paradigm of the ‘supremacy of the consumer’ (Goodwin, Ackerman, & Kiron, 2013) i.e. economic activity aims at satisfying the ‘desires’ (preferences) of people seen as agents who seek maximisation of utility via consumption of goods and services. According to this theory, utility translates to satisfaction of people’s aims (Brink, 1989), which aligns easily with the perspective of society as a collective of consumers. Preferences of individuals are different; nevertheless, they can be arranged (in economic terms) to maximise preference-satisfaction overall, considering that all (minimally rational) preferences are deemed equal. Usually, in the SD context, they are considered ‘outward phenomena’, such as, in the easiest case, the price which an individual is willing to pay for their satisfaction (Raffaelli, 2003). Utilitarianism assumes that it is possible to sum people’s utility to achieve an overall utility or total utility. In other words, utility is conceived as a measurable good distributed among different individuals². Such a principle appeals to the SD theorists as it facilitates calibration, measurement and evaluation of policies and strategies in a ‘comparable’ way. Moreover, the notion of *goods* offers a perfect frame for relating differentiated resources while connecting them to potential quantifiers. Such basic principles are at the core of several SD methodologies, such as footprint, but not made explicit as such. Yet again, utilitarianism premises are significant for environmental accounting frameworks which have relevant impacts on how SD is conceived and applied as discussed in article 4.

² Utility conceived as a measurable good is not specific to utilitarianism. Egalitarianism can hold the same view (Kamaga, 2018).

The popularity of this ethical theory in SD is also based on the utilitarian's assumption that utility comes in greater and lesser amounts. This means that a good action or policy is normally one of the available alternatives which is likely to realise the largest quantity of utility. The development of 'utility mathematical calculus' as a proxy for *good* (Harsanyi, 1995) has been most useful as a standard of comparison between sustainable alternatives. These notions are particularly dominant in the justificatory discourse of CCM effort (as co-benefits) since they are used as 'morally valid' principles for the implementation of specific strategies against climate change.

Overall, the scientific and (regional) policy documents analysed in the first two articles reveal the predominance of consequential and welfarist arguments in comparison to other moral principles. For example, much of the (socio-political) justification of certain SD actions rests on their positive (*good*) outcomes, especially concerning an increase in the cumulative welfare (*more overall good is better*) of society or particular groups. Another example is maximisation, in this case of utility (including minimising disutility), which also has a central role in the more general SD discourses (SDGs of article 4).

There is a strong relation between contemporary utilitarianism application of cost-benefit calculations, at the social level, and the way SD researchers (environmentally and morally) justify several measures and actions to reduce environmental impacts through consumption (Connolly & Prothero, 2003). They deem consumption to be the reason for most negative environmental impacts (Jorgenson, 2003), so they consider it morally correct to sacrifice smaller benefits (decrease consumption) to secure larger ones (improve environmental conditions). This idea is at the core of the discussion about environmental responsibility and accounting in article 4.

In sharp contrast to the hegemonic influence of utilitarianism, there is the growing integration in SD of other moral principles. So far, and in the context of climate change, they come from the deontological tradition, as I discussed in article 1.

The increasing inclusion of deontological principles in SD discourses and practices may come from recognition of the importance of the value that an action or a principle possesses. Some discourses and by consequence SD strategies are evaluated not on their consequences but rather on the *rightness* of their founding principles. As pointed out in article 1, policymakers and other involved agents seem increasingly concerned that SD actions follow the principle of

‘act that you use humanity, whether in your person or the person of any other, always at the same time as an end, never merely as a means’. (Kant & Gregor, 1998, pp. 31-8). In this sense, these agents are sensitive to Davis and Rawls’ priority of *right over good*.

In the analysed sources for articles 1 and 2, I detected the action-guiding principle of respect for people, which is at the heart of Kantian ethics and is shared by all deontologists. This notion of respect for people derives from our autonomy, which is part of our rational nature. Autonomy enables the human’s capacity to follow and act by duty granting grounds for dignity. People are to be respected rather than valued, since they should not be treated as objects (to value), i.e. the problem resides in the actual valuation of people.

However, a wider integration of deontological principles in SD discourse and practices would have relevant implications for the conception of SD itself and its implementation. For example, institutions that advocate and promote SD should be shaped and organised in terms of embodying (a) certain (universal) value(s), like human rights. The objective is not maximisation or promotion of human rights but rather its respect. The deontological response to value does not require that in the end there is more of the value but instead that it is considered in every step of action or deliberation.

As I argue in article 1, if SD development discourse and practices were to be morally guided by deontological principles, the focus would be on what is right and consequently on duty, distancing the SD agent’s consideration from desire (of *good*) towards to a moral ideal of the imperative. This stand favours SD attempts of universal action towards common goals, seen as universalising principles such as (environmental, social, economic) justice or (human) rights. On ethical grounds, there have been attempts to shape SD discourse around rights (Arts, 2017; Hawkins, 2010). Nevertheless, and as articles 1 and 4 show, such principles are not widely disseminated. As an example, deontological principles are particularly relevant in justification of SD as the way to guarantee that future generations have (at least) the same rights as present people (Gosseries, 2008a; Weiss, 1992).

Freedom and Well-being: Key aspects in Sustainability Ethics

In recent years, SD has begun to integrate some principles and concepts of the CA (Lessmann & Rauschmayer, 2013; Martins, 2011; Scholtes, 2010), but not to a level considered by the ethical community as being relevant enough. The initial attention of the SD community

was due to the appeal of its economic and developmental implications. In the same direction, and still questioning the preponderant role of utilitarianism in SD, I also turned to CA.

In a nutshell, CA stems from Sen's critique of welfare economics and utilitarianism based on the apparent shortcomings of goods as a measure for human development and the weaknesses of the egalitarian distributive perspective associated with utilitarianism.

My work with this approach (article 2) focuses on two key concepts: functionings and capabilities. Functionings refers to the 'beings and doings' of a person i.e. they refer to all that an individual is and does. However, it does not include the actual choice and associated freedom. Capability indicates a group of functionings. Each person can choose from this set of functionings. The act of choosing creates unique combinations that grant each person their path (Sen, 1993).

What I considered to be the most relevant feature for SD, especially in the context of co-benefits (article 2), is the notion that access to resources or goods does not ensure happiness or well-being. This is also pertinent in the environmental justice context, especially to policy design and implementation of strategies to diminish environmental, social or economic inequality. So far, the great majority of SD strategies consist in making available or giving ownership of commodities to communities or individuals (Leach, Mearns, & Scoones, 1997). However, as shown in article 2, there are limitations and undesired environmental and moral implications associated with this kind of strategy. Another attractive feature of the CA is the acknowledgement of individual, institutional and environmental factors as being decisive in the individual's possibility to achieve functionings. This means that under CA, SD strategists must integrate these factors and ameliorate them if the solutions or policies are to be adequate for people and the environment.

Another promising characteristic of CA for SD comes from Sen's acute notion of the height of social and individual contexts for achieving well-being. CA offers a nuanced picture of individual development by calling attention to two key notions: achievement and advantage. In the centre of human well-being, there are achievements in the sense of accomplishments. By focusing on them, society tends to disregard the role of possible choices that may have been available to the individuals throughout their lives i.e. processes that culminated in achievements are often ignored. In contrast, the advantage is relative because it is based on the opportunities

that an individual has in comparison to what others also have. By analysing advantage, it is possible to distinguish the personal choices and values.

Sen is alert to the apparent ‘social blindness’ towards how (formal) opportunities and agency create a dynamic that dictates the real level of well-being. This perspective challenges the ‘simplified’ vision of utilitarian’s well-being which has been dominating the social SD discourse and practices.

Another potential contribution of CA to SD, particularly associated with co-benefits, comes from Nussbaum’s neo-Aristotelian elaboration of ‘capabilities ethics’. She emphasises that human life is far more ‘real’ than the abstractions suggested in utilitarian and deontological theories. With this in mind, if CA were to influence SD, one would be required to think in a far more concrete way about how actions (would) affect the lives of individuals and consequently force changes in institutional discourses and practices, as pointed out in article 2.

On my account, the most important contribution of this ethical framework to SD, and chiefly in CCM circumstances, is placing individual freedom and choice at the centre of its concerns. Nevertheless, I would agree that the quest for (environmental) justice should go beyond personal responsabilisation. This perspective aligns with a less supported view in SD which gives greater relevance to the role of institutions in the (non)advancement of societal change, in this case towards sustainability, even when the individuals claim and act for change. As Nambiar (2010, p. 63) writes ‘the challenge to the achievement of capabilities arises mainly when individuals live in conditions where the institutional structure is resistant to change. Under conditions where institutions are chronically inefficient and show no signs of converging to a set of institutions that is efficient and productive, it becomes imperative to examine the mechanisms in question’. Such reflection calls on all of us individually and collectively to exercise our freedom in the pursuit of sustainable well-being. This mindset was crucial to the choice of the subject of article 4: the imbalanced but still shared responsibility that both individuals and institutions have in implementing SD.

Distributive justice in a Sustainability context

Achieving fair access to and enjoyment of goods, as a means of attaining a desired level of well-being, is a critical issue in applied ethics and SD. The reflection and building of principles around this intent create what ethicists denominate as distributive justice. In my work,

distributive justice is considered to be a set of norms for the allocation of resources that rational individuals would see as legitimate or fair. Commonly associated with distributive justice is procedural justice. However, I do not reflect on procedural justice even if both are commonly brought together in the societal discourse around SD.

In a distributive justice context and in my work, in particular, it is important to contemplate what the allocation criteria, the types of resource or goods and the agents involved are. Usually, allocation principles are based on merit/desert, equality and need, among other principles. Considering the sustainability paradigm, it is crucial to understand the implications of the type of distributed good, and article 5 reflects exactly on this point. The goods can be natural resources, international aid funds or CO₂ emissions but there are ethical ramifications that need addressing in accordance with their characteristics. Another important aspect to evaluate is the agents who decide how to allocate the goods and who is the recipient. This is particularly the case in climate and resource international agreements. All these justice aspects can be contentious and are in themselves motives for reflection. However, and in the case of this thesis, the focus is the set of principles that can orient a *fair* distribution (article 3 and 4), and how the type of resources might influence those principles (article 5).

Following the RQs of the thesis, the principles chosen to frame the work on distributive justice were mainly egalitarian, prioritarian and sufficientarian. The concrete reasoning for this choice is twofold. First, it has to do with the strong influence of egalitarianism (Gosseries, 2005b) and prioritarianism in recent SD discourse (Adler, 2008; Adler & Treich, 2015) and the pioneering role of the Brundtland (intergenerational) sufficientarianism in the birth of SD itself (Gosseries, 2008b). Secondly, despite the great influence of utilitarianism in SD, it is possible to individualise different positions on distributive justice in the SDG documents, for example far closer to egalitarian, prioritarian and sufficientarian theories. As discussed and sustained in articles 3, 4 and 5, these distributive justice approaches co-exist and compete for relevance in many of the climate and resource debates and policies.

Egalitarianism: Liberty and well-being

Simply put, egalitarian perspectives favour equality of some sort. The background idea for this reasoning is that all human persons are equal in fundamental worth or moral status, which is a very intuitive principle and makes it 'easy' to gather a consensus. In the case of Rawlsian distributive justice, the fundamental point is the idea of reciprocity among free and equal

democratic citizens who are socially productive and engaged in ongoing social cooperation on grounds of mutual respect. The development aims to extend individual freedom through elimination or reduction of social inequality and other conditions that can limit human freedom, development and opportunity. This resonates in many of SD's social conceptions (Gupta & Vegelin, 2016; Roy et al., 2018) and was perceptible in the policy documents that were analysed (article 3).

In many cases in SD discourse, equity is brought up through solutions to deal with social and luck inequalities. In general, these solutions aim at guaranteeing fair equality of opportunity while mitigating the impact of social background in the distribution of advantages (Holden, Linnerud, & Banister, 2017). To accomplish this, Rawls suggests the difference principle, which allows economic inequalities only to the extent that they benefit the worst-off. In this way, the difference principle lessens—although it does not nullify—the consequences of the unequal distribution of personal resources.

The thesis borrows the Rawlsian perspective for the analysis of SD policies and strategies and method development. The reasons why I set aside luck and strict egalitarianism were the theoretical difficulties and (im)practical consequences of its application in the SD context (Schuppert, 2011) (Gosseries, 2005a, 2005b). Another factor to be weighed in this decision was that in general, and mostly considering the analysed policy texts (in article 3), Rawlsian egalitarianism draws far more consensus within the SD community than any other type of egalitarianism. Consequently, Rawlsian egalitarianism seems a 'safer' choice, in terms of wide acceptance, for the development of SD methodologies (footprints) based on a distributive justice framework (article 4). Furthermore, Rawls' distributive doctrine is easier to translate to the parameters needed for footprint calculation.

Despite the great influence of utilitarianism in SD, there are Rawlsian dissonant voices which argue that purely maximising the well-being of the average person or the equality of the well-being in a society should not be the point; rather allow enough inequality to maximise the primary social goods of the least advantaged people (Arnold, 2012; Bell, 2004). In this context, primary social goods are the most representative goods of citizens' fundamental interests i.e. those that individuals prefer to have more of rather than less, and include 'rights, liberties, opportunities, income and wealth' (Rawls, 1999, p. 54).

In sum, Rawls' equality principle implicates an egalitarianism of a meritocratic ideal, with equal political participation, and equality in primary social goods to all individuals. I argue that this is one of the most important implications of Rawls' egalitarian principles for SD in the way a sustainable society should be promoted. According to his work, a society to be deemed morally healthy must guarantee freedom of choice and opportunities, while assuring the worst-off possibilities of rising in the social ladder. Consequently, a 'Rawlsian egalitarianism inspired SD' should create (organisational and individual) strategies which give people true possibilities and paths of self-promotion based on their capacities and efforts while turning any inequality to the advantage of the worst-off.

Prioritarianism: First the worst-off

In terms of distributive justice matters, SD discourses include other principles besides egalitarianism. The (content) analysis performed on the texts related to the SDGs (article 3) revealed other justice principles closer to prioritarianism. The analysed texts integrate other distributive justice positions similar to 'prioritarianism [in its] original version, which stated that 'benefitting people matters more the worse off these people are [in absolute terms]' (Parfit, Clayton, & Williams, 2000, p.101). In other words, those principles indicated that a benefit matters more (morally), the worse off the individual to whom it adds. Unlike Rawls, prioritarians are mainly concerned with absolute levels of individual welfare (Parfit, 1991). A benefit that falls at a particular level of welfare has the same moral value no matter what levels other individuals are at. Moreover, the lower this particular level, the greater the value of the benefit.

Some of the SD policy objectives I characterised as prioritarian considered the distribution of well-being (e.g. maternal well-being) based on each individual's well-being taken separately. It seemed that the absolute level of an individual's well-being was what mattered and not how her/his well-being compared with that of another individual. Moreover, the lower an individual's well-being, the greater the priority it seemed to be assigned by the documents to improving it.

It is worthy of note that prioritarians value equality indirectly, but in their view, it is always better to increase inequality when it translates into lowering the welfare of some and increasing the welfare of the worst off. Additionally, the priority view tackles the 'separateness of persons' objection to utilitarianism (Porter, 2012). Utilitarianism treats interpersonal balancing of losses

and gains in the way that a rational decision procedure for an individual life would treat intrapersonal balancing of losses and gains. This idea is contrary to the separateness of persons.

Some SD discourse sustains the idea that sacrificing (some) benefits is justified if an alternative distribution is available which realises prioritarian value to a greater degree, i.e. where the prioritarian value of a unit of benefit is greater for the worse off in absolute terms (Adler et al., 2017; Adler & Treich, 2017).

Also, in contrast to utilitarianism, which considers resources to have declining marginal utility, the overarching notion in many of the statements and objectives in the SDGs is that utility has diminishing marginal moral importance. The utilitarians give no priority at all to benefits for the worst-off but this is subjacent to the notion that it is not sufficient that the gains for the better off are greater than the losses for the worse off. In this sense, prioritarianism inclusion in the SDG texts can usefully be seen as a remedy to both egalitarianism and utilitarianism shortcomings.

Despite the lack of extensive application and reflection of this theory in the SD context, there are relevant implications of prioritarianism, especially in climate change policies (Lumer, 2009). The application of this theory would affect, among other things, the social discount rate, the social cost of carbon, optimal mitigation, and the dismal theorem (Adler & Treich, 2015). However, and since these issues were not directly connected to the RQs of this thesis, prioritarianism approach was only included in article 3.

Sufficientarianism: Guaranteeing a minimum level

In comparison to equalitarianism, the influence of sufficientarianism in SD discourse is secondary (Gosseries, 2005b). However, this is less the case in an intergenerational justice setting due to the influence of the Brundtland report. This thesis follows the same trend, so sufficientarianism is framed mainly concerning the duties of present generations towards future people (article 5). Nevertheless, I came across intragenerational sufficientarian principles during the (content) analysis performed on SDG documents, for article 3. With this in mind, it seems reasonable to reflect on this justice theory concerning distributive justice for present people, especially concerning the SDGs.

The SDG policy documents analysed contained the general sufficientarian justice notion that securing enough is of the utmost importance when considering a fair distribution of resources

or goods (e.g. maternal and new-born health). Besides this broad justice principle, other relevant sufficientarian criteria should be mentioned here since they have the potential to change a great deal the discourses and practices in SD.

It is possible to track the birth of sufficientarianism to Harry Frankfurt's *Ethics* article of 1987. Frankfurt argues that sufficiency (rather than equality, priority, or utility maximisation) determines the justness of a distribution. Frankfurt's sufficiency is ruled by the principle that everyone should have enough, i.e. to be above some kind of threshold is considered to be just. It is worth mentioning that Frankfurt's version is one of the predominant sufficientarian views included in the SDG documents analysed.

A relevant characteristic of sufficientarianism is what Casal argues as being sufficientarian dual-theses. She states that in essence there are a 'positive thesis: priority is given to benefits to those below the sufficiency level over those above the sufficiency level [and a] negative thesis: no priority is given to benefits to those above the sufficiency level' (Casal, 2007, pp. 297-8). The positive thesis accentuates the importance of individuals living above a certain threshold, free from deprivation, while the negative thesis refutes the relevance of additional distributive requirements.

What is clear is that the sufficientarian premises both in general SD discourse and in the analysed policy documents consider that precedence should be given to benefiting individuals below the sufficiency threshold over those who are above it (the positive thesis) i.e. the complete priority that disallows a trade-off between sub- and supra-sufficiency well-being. However, they omit to state specify whether this view also includes the idea that well-being above the sufficiency level is morally irrelevant (Frankfurt, 1987), or if the higher the level of well-being that people achieve, the less important it is to benefit them (Shields, 2016a), or even if there is an equal weight of well-being above the sufficiency level (Crisp, 2011).

In the specific case of this thesis, the two theses are represented in the SDGs themselves and the lack of UN additional policy recommendations for when certain thresholds are met (e.g. SDG goal 3.1 on maternal health).

Some ethicists maintain that particularly for climate change, sufficientarianism can be particularly adequate for ensuring economic justice for the deprived (Kyllönen & Basso, 2016). As Shields writes about the positive thesis, 'we have weighty non-instrumental reasons to

secure at least enough of some good(s). [...O]nce everyone has secured enough, no distributive criteria apply to benefits.' (Shields, 2012, pp. 103,106). However, SD discourse influenced by sufficientarianism does not seem to precisely define what could be the shape of the negative thesis.

In general understanding and extrapolating from the documents analysed, a sufficientarian perspective on fair sustainable development would dictate that is of vital relevance to ensure that fewer and preferably no people are below the determined level. Furthermore, a sufficientarian SD would set in motion strategies to diminish the gap between the lowest levels of well-being and the sufficiency threshold and would promote and engage in actions that guarantee a greater emphasis on the well-being of persons below the sufficiency level.

Footprints: Tools for justice?

This chapter includes general considerations about footprints, as the more technical details are left to the method section of article 4. The objective here is to make clear what a footprint describes, its influence in the scientific and policymaking spheres, and the ethical implications of the calculation and adoption of its results.

In the environmental justice debate, it is key to understand the state of affairs of system Earth, especially how the resource use and distribution is and should be among social groups (Mohai, Pellow & Roberts, 2009) or even generations (Ponthiere, 2013). To perform the task of analysing and quantifying the dimensions of SD, researchers have at their disposal indicators/indices, product- (or process-) related tools and integrated tools (Singh, Murty, Gupta, & Dikshit, 2009). The advantage of using these tools is the possibility of translating the state of very complex systems (e.g. the hydrosphere) into 'humanly digestible' information.

Among other applications, assessing sustainability is the basis for formulating sustainability strategies. Sustainability assessment tools tend to be used mainly within the scientific arena. However, there is one that quickly transcended this dimension and became integrated both in the political and laypeople's discourses: the footprint. This influence dictated my interest in its ethical analysis. Footprints are a good example both of the valuative tensions associated with sustainable development methods and of the justice implications of using quantitative tools in the discourses and policies.

Like other sustainability assessment tools, footprints have an extensive application in scientific (Baabou, Grunewald, Ouellet-Plamondon, Gressot, & Galli, 2017; Wood et al., 2019) and everyday contexts (Carbon footprint, 2020; WWF, 2018). This influence extends to the policymaking domain (European Commission, 2016), where footprints are utilised to understand and justify global and specific SD strategies and courses of action (Hammond, 2007).

But exactly what is a footprint? Footprint is a loosely used word describing different types of methods utilised to understand the use of a resource and/or impact of a particular ecosystemic component, i.e. the negative implications of human activity on the environment³. For example, footprints can tell the amount of carbon dioxide (or equivalent greenhouse gases) emitted to produce one kilogram of beef⁴ (Ruviano, de Léis, Lampert, Barcellos, & Dewes, 2015).

As mentioned previously, there are multiple interpretations of what constitutes a footprint. Besides being an indicator (type of sustainability assessment metric), footprints can also be regarded as performance metrics, or the result of the footprinting (aggregative computational) method⁵. As an example, companies use footprints to make (more) transparent the effect of their services and chains of production in the environment (Busch, 2010; Murray, Wiedmann, & Dey, 2011). Currently, many everyday products and services integrate environmental information, like the environmental product declaration integrates carbon footprint information (EPD International, 2019). In literature, the term ‘footprints’ is also used as the result of the computational method to estimate (e.g. GHG) emissions (Weidema, Thrane, Christensen, Schmidt, & Løkke, 2008), to quantify environmental (e.g. pollution) (Min, Jiao, & Cheng, 2011) and social impacts (Fortier, Teron, Reames, Munardy, & Sullivan, 2019; Neugebauer et al., 2014), and to measure natural resources use (e.g. land, water) (Egan, 2011; Hoekstra, 2013).

In sum, and in general, footprint can be (any) aggregated environmental performance metric from a product, a company, an activity, or a geographical/administrative territory. There are three methods for the estimation of footprints: i) the process life-cycle assessment approach

³ Complementarily, researchers developed ‘handprints’ as a means (metric and method) to evaluate (personal or collective) strategies taken to mitigate environmental impact and quantify the positive influence of products or services (Norris, 2015). In simple terms, to achieve SD, it is necessary to reduce one’s footprint while increasing the handprint (good effects to society and the environment).

⁴ This type of information is originated by an LCA study, which in general terms can be combined with input-output analysis to assess the environmental impacts of a particular (e.g. food) value chain associated with a product or service (e.g. meat) in a region or country (e.g. Finland) (Virtanen et al, 2011).

⁵ For more information on the different definitions and interpretations of footprints see (Wiedmann & Minx, 2008).

(LCA), ii) the environmentally extended input-output analysis approach (EEIO), and iii) the hybrid approach (hybrid-LCA) which is a combination of LCA and EEIO (Giljum, Lutter, Bruckner, & Aparcana, 2013, p. 10). The main difference between the LCA and the EEIO approaches is that the first estimates the potential environmental impacts of multiple different environmental impact categories (acidification, climate change, eutrophication, eco-toxicity, etc.) of a product, service or activity, on the basis of a detailed process inventory over its entire life cycle, while the latter estimates the aggregated potential impacts (according to the chosen scope; like water consumption, or greenhouse gas emissions) on the basis of environmentally extended econometric data for the sectors the given activity involves and draws upon. Hence, process LCA is commonly used to examine given, well-defined design alternatives of individual products or goods, while the EEIO approach is better used for estimating the aggregated impacts of an activity that involves consumption of numerous products or goods. Strictly speaking, the industrial ecology research area refers to carbon footprint as the aggregated greenhouse gas emissions according to the EEIO approach, when used for instance to estimate the footprint of a person or a company.

In this thesis and in a stricter sense, footprints are regarded as quantifications of (direct and/or indirect) aggregated environmental indicators such as carbon dioxide equivalent emissions, water use, and land use. The method used to develop a new footprint methodology based on justice concerns (article 4) is input-output analysis. This choice does not reflect any form of demerit of the other methods but rather, my greater familiarity with input-output analysis and the fact that this method is (also) scientifically robust and widely accepted within the scientific community (Moran & Wood, 2014; Weinzettel, Steen-Olsen, Hertwich, Borucke, & Galli, 2014). It is worth remarking that my reflections on the impact of footprints in policy and everyday life are not restricted to the ones originated from this estimation method, but include all the ways footprints are/can be interpreted.

Generically, footprints can be calculated using input-output analysis via two types of accounting approaches: production-based accounting and consumption-based accounting. Production-based was historically the first accounting methodology to calculate footprints. It counts the resources used or emissions and impacts made within system boundaries⁶. It is an approach less relevant these days but still in use by international institutions, like the

⁶ The system boundary considered in the production-based footprint is defined by the particular objectives of the study and does not have to include the totality of production phases or regions where the impacts are originated.

Intergovernmental Panel on Climate Change, IPCC or the World Resources Institute. Paramount climate change agreements are based on this approach to footprint, which demonstrates the great political influence of this method. Consumption-based accounting for footprints was developed after production-based accounting. It counts the resources used or emissions and impacts made within the system boundaries and supply chain, from a life-cycle perspective. This last fact is key to the greater acceptance of consumption-based footprint by scientists (Steen-Olsen, Weinzettel, Cranston, Ercin, & Hertwich, 2012)⁷.

Before continuing to characterise footprints, I will take a side-step to briefly comment more on LCA. The main reason for this (maybe) digression is that LCA (the scientific method and the product/process related sustainability assessment tool) and (certain) footprints (for example, estimated by this method) share methodological principles, which are relevant enough to influence the results, and by extent the way some certain actors are made responsible for the impacts in the environment. This relation and the influence of those shared principles have policy-making importance. An illustration of the (environmental and socio-political) relevance of this commonality is the case of packaging tax by the Dutch Government (Weidema, Thrane, Christensen, Schmidt, & Løkke, 2008).

One of (potentially) shared principles is 'life-cycle thinking'. This perspective requires going beyond the focus on production site and manufacturing processes to include environmental, social and economic impacts of a product over its entire life cycle⁸. In the case of footprints, this principle translates in the accounting of the emissions, uses or impacts in all the phases of the life-cycle of a product or process, which only happens in the consumption-based approach.

Another reason why LCA is relevant to this thesis has to do with its evolution towards the recognition and integration of values and ethical principles in sustainability assessment tools (Baumann et al., 2011; Finnveden, 1997; Freidberg, 2018). In SD scientific research, for example, within the field of (political) industrial ecology, the added value of this integration in

⁷ To better understand the difference between the two ways of calculating footprint, let us use the example of how meat affects the environment, and in this case, the water resources. To calculate the production-based water footprint of 1kg of beef coming from producer X, there are two possible ways. If it is a production-based footprint, the data for water use included in the calculation tables refers to the cows' drinking water, the water to wash them or to clean the farm facilities. In the case of consumption-based accounting, it includes the same water uses as in production-based, plus other uses like the water needed to grow the animal fodder that producer X buys on the market or the water necessary for manufacturing the steel of the farm facilities and water used for end-of-life purposes (e.g. recycling the manure).

⁸ For more detailed information on what is a life-cycle, read the website on life cycle initiative at <https://www.lifecycleinitiative.org/starting-life-cycle-thinking/what-is-life-cycle-thinking/>.

the resolution of the multifaceted SD challenges has been recognised (Breetz, 2017). But the path of recognition and integration of values and ethical principles does not come without challenges regarding both methodologically (Ekvall, Tillman, & Molander, 2005) and application wise, especially in justice debates (Macombe, 2014). I believe the same trend is happening/ will happen in the case of footprints, and article 4 is a small contribution in this direction.

The application of sustainability assessment tools, in studies and policies, creates normative implications, which have not been adequately studied. Nevertheless, there are relevant works on waste management (Lazarevic, 2018), food (Goldstein, Hansen, Gjerris, Laurent, & Birkved, 2016) (conferencing LCA), and more generally on indicators (Hofstetter, Baumgartner, & Scholz, 2000) about the moral aspects of the design and use in policy-making of sustainability assessment tools.

One of the most significant moral implications of utilising sustainability assessment tools is making accountable of particular agents i.e. addressing the question about who and to what degree an agent is liable for the effects of a product or service.

Implicitly and due to the calculation method, footprints assign environmental responsibility either to consumers of goods and services or to the manufacturers (producers) in a dichotomous fashion. A simplistic attribution of environmental responsibility for emissions, resource use or environmental impacts does not adequately portray the intricate commercial and trade relations⁹¹⁰. It fails to correctly show to what extent each agent (producers and consumers) contributes to environmental impacts. Consequently, such a position should be morally challenged.

Currently and in most cases, footprints are calculated with a consumption-based perspective, which means that the final consumer is pointed out as the sole agent accountable for the impacts, emissions or resource usage. In the cases where the production-based footprint is utilised (e.g. Intergovernmental Panel on Climate Change), the producer(s) (more accurately the industries of a particular nation) answer(s) for the impacts, emissions or resource usage.

⁹ This can be mitigated to a certain extent if the study results are critically presented, and discussed on this account. However, such steps are commonly absent both in scientific literature and in commercial footprint studies.

¹⁰ In a similar fashion, the way the LCA is calculated (attributional and consequential) attributes environmental responsibility to agents in different manners. For more on this, read Brander, Burritt, & Christ (2019).

As extensively described in the article, the non-reflexive adoption of footprints as (sole or most relevant) measures of environmental responsibility, and the consequent (implicit) choice of the agent responsible for the (negative) impacts, creates grounds for injustice. One particular case relates how (consumption-based) footprints are used to collectively ‘shame’ consumer/citizens’ choices (Hume, 2010; Vanderheiden, 2010), often disregarding relevant socio-economical asymmetries that affect societal groups’ consumer patterns.

Since environmental assessment tools in general, and footprint in particular, provide information and guidance for policy and decision-making processes (IOM & UNDESA, 2012; UNESCO, 2009), it creates other dimensions of responsibility besides environmental accountability. For example, footprints have distributional justice implications because they give comparable information about the (carbon) emissions of different consumption patterns according to household expenditure (Sommer & Kratena, 2017). The footprint method is also used in policy documents on future trends of emissions and resource use, especially concerning future SD scenarios (Brandt-Rauf, 2010). These scenarios will condition the design and application of political measures which will affect people’ livelihoods. Despite the relevance of distributional and other relevant ethical implications of footprints I will not mention them, since they are outside of the scope of the thesis.

In sum, footprints are a relatively simple way to (1) understand and (2) quantify systemwide stressors that will potentially impact the environment, (3) assign environmental responsibility to an agent, and (4) determine to what extent that agent (or a process) contributes to an environmental impact. Such characteristics make footprints key elements in the environmental assessment which is at the heart of SD policies, which, on their turn, affect the lives of all of us (Alvarez, Carballo-Penela, Mateo-Mantecón, & Rubio, 2016). To be able to take full advantage of footprints, and of other environmental assessment tools, it is necessary more work on the articulation of ethical reasoning and methodology development. Fortunately, this task is being currently done by both the scientific (e.g. industrial ecologists) and the ethical researchers.

A Fair and Sustainable Future: On Intergenerational Sufficiency

The 1970s and 1980s saw the start of research on obligations to future generations. This beginning is associated with the rising concerns about the environment and the effect of human activity on the degradation of the planet. In recent years, the term intergenerational justice has

gained traction mainly associated again with the acknowledgement and wider implantation of SD.

Several SD theories include principles of intergenerational justice, mainly utilitarianism and egalitarianism. In the case of this thesis, only the sufficientarian approach is described since intergenerational utilitarianism and egalitarianism were not decisive for the elaboration of the articles that deal with distributive obligations to future people (article 3 and 5). The general reasons why I considered it relevant to develop intergenerational sufficientarianism under the SD paradigm (article 5) will be discussed in this section. However, the more detailed reasoning for choosing this particular justice approach for distributive justice suggestions in the context of SD (article 5) and in particular for SDGs (article 3) will not take place in this part of the thesis, as they are fully accounted in the theoretical section of the mentioned publications.

In general, sufficientarianism states that there are weighty reasons to provide certain goods up to a certain threshold of ‘enough’, while the reasons for providing more, or different goods, are less weighty, and are also likely to be of a different sort (Shields, 2012). This reasoning has several implications, the more general being that present generations need to act so that future people attain a certain threshold of well-being and that after this level is guaranteed, our present generation need not reflect on how to deal with inequality not based on distributive justice principles. The ‘nature of the good(s)’ that are subject to the threshold varies from well-being to capabilities and (human) rights.

The most important justification for my interest in intergenerational sufficientarianism resides in its theoretical robustness when compared to other justice theories (Gosseries, 2011). For example, when we address *justice metrics*, intergenerational sufficientarianism is quite flexible because it contemplates either a sufficient level of well-being (Shields, 2016b), rights (Bos & Düwell, 2016) or capabilities (Nielsen & Axelsen, 2017). This is useful since the general necessities of people are rather constant over space and time, as well as their rights and capabilities. These basic needs should not be considered here as a defined set of needs but rather a family of requirements characterised as being necessary for a human being to survive with a sufficient quality of life. The concrete translation of those needs in practical terms may evolve but the necessity will, in essence, be the same, e.g. human interaction used to be mainly in-person but it now it occurs frequently via the internet. Such plasticity solves part of the uncertainty associated with establishing what will be the *needs* of future generations, which is particularly critical in a sustainability paradigm.

Another characteristic explaining why I choose to work with sufficientarianism is its approach to the question of non-identity of future generations (Parfit, 2017). For example, Meyer and Roser (2009) suggest using a possible rights violation on a sufficientarian account to respond to this problem. They focus on the right of future generations not to fall below a certain level of well-being. According to them, this right is violated if the present generation does not refrain from carrying out actions (negative duty) that could cause future persons to end up below the well-being threshold. Also, they point to a positive duty to make sure that future persons reach a level of well-being at or above the threshold level of well-being.

In general, the negative sufficientarian thesis advocates that there are no more duties beyond the positive thesis; which translates into the conclusion that it is not necessary to share the goods equally with future generations (Casal, 2007) or that equal distribution is not intrinsically good (Huseby, 2010).

In the SD context, the concept of basic needs is frequently used when addressing justice for future generations. In sufficientarian terms, basic needs translate to elements that are indispensable to human life and are unalterable through time and environmental conditions (Brock, 1998). Consequently, some authors like Page (2007) push forward the notion of ‘global needs sufficientarianism’ as an effective approach to deal with the SD challenges and trade-offs, particularly in the case of the SDGs. However, this ‘low threshold’ vision draws intense antagonism since some believe it advocates only for very low standards that do not ensure decent levels of well-being (Streeten, 1984).

Besides substantive sufficientarianism (basic needs), there are alternatives like ‘institutional sufficientarianism’, which is close to Rawls’ proposal to limit the violation of maximin as much as possible to what is necessary to support institutions (liberal and freedom tradition). This alternative and ‘life-worth-living’ sufficientarianism have higher demands in terms of a threshold of well-being when compared to the basic-needs approach. However, and as Gosseries (2016) points out, this might still not be good enough when we consider what kind of future we would like to leave for generations to come. Article 3 partially addresses the issue and presents a proposal for evolving thresholds as a practical way of increasing the stakes towards better levels of well-being for future generations.

Under the paradigm of (strong sustainability) SD, there are other relevant questions for the achievement of distributive justice for future people that need to be reflected upon. The main

reason rests on the notion of planetary boundaries. The fact that Earth has several endangered 'planetary life support systems' (Rockström et al., 2009), some of which cannot be replaced by any human-made alternative, makes it evident that this situation can/will affect future generations.

In direct relation to the 'state' of planetary boundaries, there are the questions of inheritance, i.e. what each generation inherits from the preceding one should affect or should not affect the pattern of distribution of goods and burdens.

Strong sustainability presupposes that economic and environmental goods are complementary, but not totally interchangeable. Strong sustainability ascertains that there are particular environmental functions that cannot be accomplished by humans (Holland, 1997). Consequently, the inheritance of those environmental elements is a cornerstone issue for intergenerational justice.

Contrary to other justice theories, sufficientarianism does not consider what each generation receives from the previous one to establish the minimum required level for future people. This principle translates to the non-obligation of present people to save or accumulate resources or goods if they can establish that future people will be able to achieve a level of sufficiency. Consequently, the present generation cannot dissipate resources or goods if it translates to risking a minimum level for generations to come. Nevertheless, such looseness in the management of resources might have unwanted consequences. Article 5 of the thesis analyses the implications of the negative thesis in a general setting and offers a theoretical proposal to harmonise SD and intergenerational justice.

Another of the relevant points for distributive justice in the SD context is the variation in population size. Contrary to other ethical theories, sufficientarianism is sensitive to demographics (Gosseries, 2011) because its focus is the outcome of the distribution instead of the application of particular distribution principles. If there is a constant number of goods to be distributed to future generations to ensure sufficiency, the number of recipients of those goods becomes very important in the case that they increase beyond a certain limit. This characteristic is particularly relevant for the design of SD strategies because the growth of population is a tendency that does not seem likely to change in the coming years (Bongaarts, 2009). Of course, the global effect of population growth in the determination of the level of sufficiency can be deemed a challenge for sufficientarian SD practices. Still, it is not impossible to overcome, as

there are robust estimates. Maybe the most challenging barrier to the implementation of sufficientarian principles in SD is to properly deal with local resource allocation issues (e.g. potable water), since their assessment is still quite uncertain.

Despite the traditional good acceptance of sufficientarianism in SD (Gosseries, 2005b), there are still many ethicists who think that (more) egalitarian considerations should be considered as well (Meyer, 2018), especially because of the negative thesis implications. For those who find that future people should have access to the same conditions as today, the present generation should ensure they leave the planet equally valuable (resources) as what they inherited. This position presupposes the acceptance of the substitutability of goods, contradicting the paradigm of strong sustainability. Strong sustainability is gaining increasing support in SD theory (Holland, 1997; Wilson & Wu, 2017) which is another reason why my thesis, mainly in article 5, focuses on developing sufficientarianism under this paradigm, so it becomes a stronger alternative to egalitarianism.

Methodological Framework

The objective of this chapter is to clarify and present the approach adopted in this thesis to answer the general and specific RQs described in section Hypothesis and Research Questions.

Although this is a thesis in applied ethics, it was written in collaboration with other researchers and carried out in a multidisciplinary community. In consequence, the research resorted to both ethical and scientific methodologies and tools. Nevertheless, the focus of this chapter rests on the philosophical approaches due to the nature of the scope of the work. Hence, the description of scientific tools is far more summarised, leaving the methodological details of the articles to their methods section.

Methods in Applied Ethics

The objective of this section is to introduce the most important philosophical methods used in the accomplishment of the research. The methods described below were applied in the elaboration of the thesis and the articles included in it. Nevertheless, they are not explicitly described in them. The reason is that ethical tradition does not usually require the integration of a method section in its articles. This fact and the space constraints due to editorial guidelines dictated that they are only described in the thesis corpus.

Symbiotic Empirical Theory Ethics and Interdisciplinary Multilevel Applied Ethics Methodology

Ethical research in sustainability as an organised corpus is rather new (Becker, 2011; Cairns, 2003; Kibert, Monroe, Peterson, Plate, & Thiele, 2011). This situation requires the ethicists who analyse SD to develop new methodologies and/or to apply methods originally established for other areas. In light of this, I found it helpful to draw some comparisons with some other recent fields of applied ethics to develop my work.

Due to the nature of the RQs, it was necessary to engage in a multidisciplinary approach to the object of study, often using descriptive and normative components for ethical deliberation. In this thesis, the descriptive activities consisted mainly in characterising several aspects of SD while proposing, defending, analysing and applying descriptive principles and concepts. The objective was to make clear or bring to light the (non-apparent) ethical tensions and dilemmas in SD discourses (e.g. co-benefits), methods (e.g. footprints), practices (e.g. climate change

strategies) and policies (e.g. SDGs) that are regarded by many researchers and policymakers (agents) as morally neutral. The other part of the work was normative and consisted in proposing, defending, analysing and applying normative frameworks (e.g. justice, fairness) and principles (e.g. sufficientarianism, conditional freedom) in the SD context (e.g. transportation, afforestation).

The articles follow a general methodology called the ‘Symbiotic Empirical Ethics’, which consists of five steps: ‘setting out the circumstances; specifying theories and principles; using ethical theory as a tool of analysis; theory building; and, finally, making normative judgments’ (Frith, 2012, p. 201). The sequence of elements is not fixed and might change when relevant to the analysis being conducted.

More precisely, in articles 1 and 2, initially, there is a description and analysis of particular climate change mitigation strategies, while in articles 3 and 4, the ‘contexts’ are respectively the SDGs and SD method of footprints. As a second step, I give an account of which theories and principles can apply to the described circumstances. In this second step, I used the several theories described in the previous section. In the third step – theory building – as Frith (2012, p. 203) writes, ‘theory can be used to approach the data and it can also arise from the data itself. Then the theory might be modified or extended – theory interprets data and data interprets theory – and the two processes can occur in the same study’. This was particularly the case in article 5, where the corpus of intergenerational sufficientarianism was extended by the proposal of a new concept (irreplaceable goods) derived from the analysis of performed in article 3. The normative judgments step was also integrated into all the articles. For example, articles 1 and 2 question whether co-benefits are morally justifiable or not.

The interdisciplinary nature of the theme requires the application of another methodological approach – Interdisciplinary Multilevel Applied Ethics methodology (Brey, 2000). This approach was applied and modified to the SD context since it was originally proposed for computer ethics.

I argue that, like computer ethics, SD requires an approach that is multilevel and interdisciplinary because SD requires a systemic approach to its multiple dimensions (e.g. ecological, social, economic) and scales (e.g. temporal, geographic). In a similar way to what was proposed by Brey (2000), my work took place in three such levels: at the disclosure level, practices (e.g. CCM strategies) and tools (e.g. footprint) were analysed for relevant moral

values like justice, well-being or rights. In all the articles, there was a second stage – the theoretical level – where a moral theory was developed or refined. This can be identified in themes like footprints or CCM strategies, which were innovatively developed within distributive justice and capabilities frameworks. The third level – application – is also present in all the articles. In varying degrees of specificity and concreteness, moral theories (e.g. deontology, utilitarianism, capabilities approach) were applied in analyses which were the outcome of research at the disclosure level (e.g. co-benefits). My research also displays a two-level approach (non-disclosive) when the moral considerations were evident, which was only the case of article 3 with the SDGs. Here, the first level was redundant and therefore skipped.

Scientific Methods in Sustainable Development studies

The objective of this section is to introduce the empirical method used in the accomplishment of the research. The elaboration some of the articles included in the thesis (articles 1, 2 and 3) required the method described below.

Content Analysis

To understand the ethical tensions and the values hidden the SD discourses, especially in policy documents, it was necessary to extract information of interest from them. This task was part of the disclosure level (of the interdisciplinary multilevel applied ethics methodology) where values and principles were surveyed using a method called content analysis¹¹. The method relies on the notion that language is an irreducible part of science and policy, dialectically interconnected with other communicational elements.

¹¹ With the increase in complexity of the issues addressed by applied ethics, researchers have become more open to broader perspectives and to the inclusion of expertise coming from other disciplines. In several sub-disciplines of applied ethics (e.g. empirical bioethics, business ethics and responsible research and innovation) there has been an attempt to systematically integrate and articulate classical ethical and scientific methods (Alvarez, Thorseth, & Carson, 2019). In this thesis, I used content analysis to make apparent subjacent normative positions in SD discourses and practices, which can be helpful in the establishment of moral aspects of a specific issue. However, the value of content analysis (or any other scientific method) to the advancement of applied ethics research cannot be generalised, as it directly depends on the research questions. For example, the ‘non-presence’ of a moral principle in gatherable data means solely that it was not possible to empirically establish its existence via this tool. More importantly, the presence or absence of a principle, in a written or spoken source, should not be interpreted as validation or (acritical) acceptance of the principle in that context. Discourse analysis does not serve to discern the merit of a particular normative perspective or principle, in a particular context, but can be helpful, on certain occasions, to an ethicist to set the circumstances of a phenomenon with moral facets.

Several types of discourse analysis are available (Van Dijk, 1997). However, in this thesis, the search for meaning in policy documents was performed via content analysis, as it was the best suited to capture the ethical values and principles embedded in the texts.

In general terms, content analysis is a 'research method that provides a systematic and objective means to make valid inferences from verbal, visual, or written data in order to describe and quantify specific phenomena' (Downe-Wamboldt, 1992, p. 314), i.e. it is a process that diminishes the volume of analysed text while identifying and grouping it in classes so it is possible to extract extra-meaning from the text.

In the context of this research, content analysis was applied in both a quantitative (Krippendorff, 2018) and a qualitative way (Downe-Wamboldt, 1992).

Content analysis was performed in a pre-stage of the elaboration of articles 1 and 2. Since these articles were elaborated for an audience of ethicists and in journals of this discipline, there is no direct reference to the method in articles. Nevertheless, the results obtained with this method are the *raison-d'être* of both articles. The results are also foundational for the developed argumentation.

Articles 1 and 2 were based on qualitative analysis with an interpretive objective. In qualitative content analysis, data is presented in words and themes, which makes it possible to draw some interpretation of the results. In the case of this thesis, I chose the analysis to be both 'manifest' and 'latent analysis'. For example, in article 1, I described 'what' texts portray, using the words themselves (e.g. *benefits*), and identifying the visible and obvious message (manifest analysis). In contrast, and article 2, I used interpretive skills to find the underlying meaning of the text (e.g. *health improvement*) (latent analysis) (Bengtsson, 2016).

Despite the analytical nature of content analysis, I took a reflective approach to the process of the conception of articles 1 and 2, as Erlingsson and Brysiewicz (2017) describe it. In this sense, for the elaboration of the manuscripts, there was a continuous process of condensing, coding and categorising, and going back to the raw texts (e.g. Norwegian policy texts on e-vehicles, Hasselt city mobility plan) to check the adequacy of the originated categories. Only in this way was it possible to extract their moral meaning. It was a reflective process that was repeatedly performed throughout the elaboration of articles 1 and 2 and was fundamental for establishing the pertinence and the justification of both articles.

The role of content analysis is also central for article 3, as this manuscript was built on the results of this method. In this case, the target audience was wider in comparison with articles 1 and 2. The population intended to read this article extended to social and natural scientists. Accordingly, the performance of content analysis in the policy documents (SDGs) is fully described in the article.

In article 3, quantitative content analysis was performed. In this case, words extracted from the text (SDGs) and presented in the form of frequency expressed as a percentage and in the actual numbers of key categories. For example, words like *universal*, *equality* or *global* justice were searched for in the SDG documents and their frequency was calculated to determine what distributive justice positioning was more relevant. The objective was to summarise details concerning the message set (distributive justice positioning), in a measurable way.

Outline of the Study

This chapter is dedicated to the articles that constitute the thesis and is organised in three thematic sections - co-benefits, footprints and future generations - with the last section being divided into two sub-sections - intergenerational sufficientarianism and SDGs. The thematic organisation (and sequence of article presentation) aims to emphasise how each article fits the research architecture and responds to the general RQs. It also guides the reader through the most relevant findings. In each section (and sub-section), I give an account of how each manuscript tries to respond to the specific RQs and how they contribute to the development of both applied ethics and sustainability sciences.

In general, the sections are organised in the following way: first, the reasons for the article are enunciated in relation to the RQs, followed by a summary, and finalising with the most important conclusions. The articles' description includes their contribution to the field(s) of knowledge. The articulation of the different overall and more general outcomes of the research are left to the final chapters of the thesis.

An Ethical Reflection on Co-benefits in Climate Change Mitigation Strategy¹²

One of the most prominent challenges for SD is climate change. This importance is the reason why my first two articles are devoted to CCM. Since the set of actions CCM is quite wide, I focused on the ones that (may) improve other aspects of SD besides climate: CCM with co-benefits.

Articles 1 and 2 (partially) address the general RQs, by using the example of CCM strategies with co-benefits (SD practice) to show how and why moral tensions (can) exist in SD discourse and practices (RQ I), to give an account of the influence of moral principles in a particular SD practice (RQs II, III), to enunciate some of the environmental and social implications of the co-existence of competing moral principles (RQ IV) and (RQ V) to propose solutions which can shape future SD initiatives.

¹² This section is based on article 1 and 2: Oliveira, R. V., Thorseth, M., & Brattebø, H. (2018). The Potential Of Co-Benefits In Climate Change Mitigation Strategy: An Opportunity for Environmental and Social Justice. *Journal of Social Sciences Naresuan University*, 14(1), 14_163-191. Oliveira, R. V., & Thorseth, M. (2016). Ethical implications of co-benefits rationale within climate change mitigation strategy. *Etikk i praksis-Nordic Journal of Applied Ethics*, (2), 141-170.

More specifically, both articles try to respond to (1) what are the moral aspects of co-benefits of CCM?; (2) and are these moral dimensions of co-benefits explicit?; (3) what are different arguments that sustain co-benefits as a moral object?; (4) what ethical consequences and dilemmas arising from a co-benefits approach and its rationale?; (5) what are the limitations of the current forms of moral justification in co-benefits rationale?; (6) can co-benefits be morally justified within the CCM debate, and if so when and how?; (7) what are the strengths and limitations of co-benefits as a moral promoter of CCM action?; and (8) can a co-benefits rationale enhance CCM strategy, and if so, how?

Both articles address certain ethical implications of specific SD policies (forestation and urban transportation) included in CCM effort. The specific subjects of the first article are the moral framing of co-benefits and their justice implications, while in second, the subjects are the moral consequences and dilemmas that arise from CCM actions, in cases where the co-benefits rationale exerts a clear influence.

In the context of both articles, co-benefits are emerging advantages of the application of certain CCM actions, i.e. positive outcomes besides the decrease in CO₂ emissions that occur from specific mitigation actions. For example, the decrease in oil consumption creates several co-benefits like the reduction of emissions of air pollutants, improved human health or the creation of jobs in green energy industries.

The reasoning for both articles is that despite the current literature on co-benefits being quite extensive, it focuses almost exclusively on economic (He et al., 2010; Jakob, 2006) and environmental facets (Plantinga & Wu, 2003; Ürge-Vorsatz, Novikova, & Sharmina, 2009). Surprisingly, there is little written about the ethical ramifications of co-benefits. Additionally, the great majority of the literature on CCM with co-benefits is laudatory (Ganten, Haines, & Souhami, 2010; Smith, 2013), with limited reflection on implications or potential trade-offs, as the 2019 Global Sustainable Development Report abundantly refers to. With more and deeper research of the interlinkages among SDGs and socio-economic sectors, the present scenario of single focus on economic and environmental aspects would change and open more opportunities for ethical analysis.

Articles 1 and 2 contribute to the co-benefits thematic by making evident the moral tensions in the discourses. I argue that ethical reflection on co-benefits is crucial because they are used as means of political justification and argumentation in favour of CCM effort (Nemet,

Holloway, & Meier, 2010; Toly, 2008). In other words, co-benefits are a pragmatic means of justification for CCM strategies, so they deserve moral scrutiny. This research (more specifically article 2) aims to provide insight on some of the limitations of the current forms of moral justification in co-benefits rationale, focusing on consequences and dilemmas arising from a co-benefits approach and its rationale. Additionally, it offers some perspectives on the strengths and limitations of this approach as a moral promoter of CCM action. It also contributes to the field of climate change studies (and in general to SD) because it reflects on some of the hindrances of the current forms of moral justification of CCM. Additionally, the articles purpose new perspectives on how co-benefits can become a tool for social and environmental equity when certain moral values are included in the discourse and practices.

The basis of the manuscripts is a (discourse) analysis of several (scientific and political) documents on co-benefits. The results (not included in the final article) show that most co-benefits research and strategising focuses on the utility of additional positive CCM outcomes, i.e. there is a distinct consequentialist moral frame in CCM practices which generate co-benefits. Researchers and political institutions tend to describe the potential positive consequences of CCM in a (more) quantitative way to make the gains more tangible to people.

I argue in the articles that when considering the rationale of co-benefits, it is not enough to look for (more) *good* but instead, it is vital to understand if that *good* is also *right*. In other words, it is of utmost relevance to know if CCM strategies with co-benefits creating or increasing (more) advantages (good) are actually the adequate strategies to be implemented, or if they (can) go against particular moral principles, duties or rules (e.g. justice).

I maintain that the utilitarian approach to co-benefits disfavours the choice of CCM strategies where processes are the outcomes, such as the case of stakeholders' involvement in decision making. Moreover, I claim that the political discourse and praxis, corroborated by the scientific stance on co-benefits, create a misplaced idea of the certain achievement of justice. However, quantifications of potential *good* do not show the distribution of this *good*. As it is, co-benefits discourse and praxis deepen social inequalities, which is contrary to the principles of SD.

With paper 1, I wanted to strengthen the general argumentation for sustainability and SD that goes beyond the utilitarian matrix. I maintain that scientific and political institutions should become aware of the (moral, environmental and social) implications of integrating

deontological principles. In other words, I claim that moral arguments that target rights and individual dignity should systematically integrate CCM and co-benefits discourses and by extension their praxis. If deontological arguments were to be (extensively) included, environmental policies would also have the added social value of facilitating social acceptance and engagement to CCM because it would be based on widely accepted values.

It is relevant to bear in mind that climate mitigation does not have a homogeneous effect and the same holds for the potential added benefits. This means that by considering climate change strategies with co-benefits targeted to improve the lives of the worst-off, we might also be rendering them (more) justice.

Despite the strong influence of utilitarianism in the current CCM strategies, it is possible to change the overall scenario, so (present and future) initiatives become an improved instrument of emancipation and amelioration of the worst-off. I propose that CCM strategies originating co-benefits and co-benefits themselves should be weighted within a moral frame that includes rights and dignity. Plainly put, policymakers should include, as decision criteria, moral principles based on deontology. The integration of deontological principles can start at the phase of CCM strategy design and continue through the implementation phase to guarantee that values like respect, dignity and human rights are also framing the emergent co-benefits. The article describes the REDD⁺ programme as an example of the potential of deontological principles in concrete CCM actions.

As hinted at in article 1, and described in article 2, co-benefits are used to support acceptance and compliance with policies and regulations aiming at CCM (rhetorical-persuasive mode), and as an attempt to weigh and assess their justifiability (ethico-economic mode).

Like article 1, the case studies of the second article are the basis of analysis (via interdisciplinary multilevel applied ethics methodology), but in the context of urban transportation.

Why urban transportation? It is the largest single source of global transport-related carbon emissions and the largest local source of urban air pollution. Furthermore, urban transportation is an SD area that greatly affects individuals' daily life and is accordingly a hot topic in SD policymaking. The case studies were selected as illustrative examples of trendy SD strategies on city transportation.

One of the most radical approaches to ‘greener’ urban mobility was adopted in the city of Hasselt in Belgium¹³. The programme consisted of making public transportation free of charge. The other case study was the contrasting urban mobility initiative to tackle climate change and took place in Norway. Both urban transportation strategies included a goal directly related to the decrease of urban GHG emissions and other explicit aims such as pollution mitigation and traffic reduction, which are clear co-benefits.

In these case studies, the co-benefits rationale, in terms of ethico-economic use, is infused by a utilitarian approach, but at the same time, it also integrates deontological jargon and some deontological influences.

In terms of moral justification, co-benefits and their rationale can be supported through a rights perspective (as discussed in article 1) but not in all cases, as argued in article 2. As mentioned in the second manuscript, it is challenging to argue for economic support of (expensive) electric vehicles based on deontological arguments. Utilitarian arguments are also not a good alternative for general co-benefits moral justification (as argued in articles 1 and 2). For example, it is difficult to maximise electric transportation while maintaining the primary goal of CCM and this does not safeguard the interests of minority groups (e.g. cyclists), since the utilitarian principle of increased good for more people subordinates the good for a lesser number of individuals.

In this second article, I argue that CA offers other relevant arguments for a more integrative moral justification of a co-benefits rationale besides rights and dignity. CA gives priority to (human) well-being and freedom, instead of, for example, more advantageous outcomes (e.g. green employment). CA accommodates both the uncertainty of co-benefit outcomes and possibly some problematic trade-offs. Under CA, it is possible to justify the co-benefits and the CCM actions that originated the co-benefits. The evolving nature of CA’s well-being concept accepts more and newer capabilities and ways to achieve them. The evolving description of well-being in CA can also effectively account for the socio-economic and historic-cultural contingencies which a co-benefits rationale faces in particular sub-settings of the original political or geographic incidence. Moreover, a CA framework may help decision-makers deal with co-benefits trade-offs by sharing the burden of decision with the rest of the citizens, via a

¹³ Other cities in Europe and even in the USA have or have had similar mobility strategies where public transportation was free or almost free of charge (e.g. Geneva; Tallinn; Olympia, Washington). Recently, Luxembourg approved this measure for the whole country.

(participatory) social consensus, and by reinforcing the importance of civil society through democratic procedures.

If CA would influence the co-benefits rationale, freedom and well-being would be the key guidelines for establishing any CCM programme, and most likely it would create a more bottom-up, democratic procedure, where citizens would dictate which CCM strategies they would prefer and its outcomes. I maintain that this way, CCM strategies and co-benefits would be guided by the value of social justice since they would be focused on enhancing people's valuable doings and beings. Furthermore, under CA, co-benefits and their rationale could become better allies of CCM action in view of being grounded in a moral framework that integrates change and diversity.

In general, I support bringing forward (new) arguments for CCM action, which do not relate directly to scientific and political concepts but belong to the moral realm. Among other advantages, including ethical principles has the added value of better engaging laypeople in SD. Including moral arguments that accommodate the moral expectations of those who are on the fringe of society (e.g. indigenous populations involved in afforestation actions) gives these communities a fairer chance to take part in a sustainable future.

In sum, co-benefits hold moral aspects even if not made explicit, especially because they have the potential to affect the environment, human well-being and the livelihoods, in ways that can promote (in)justice. As debated previously, if certain values (e.g. human rights, freedom, well-being) are not clearly included in CCM discourse and strategies, and moral and environmental implications are not considered from early stages of CCM strategy design, there will be unwanted moral consequences. As co-benefits rationale is now used, to support and justify, sometimes, potentially unfair CCM actions, may be creating additional barriers to SD implementation. This can be altered if CCM discourse and strategies were to embody values like human rights, freedom and well-being.

Rethinking Footprints under the lenses of Justice¹⁴

The design and implementation of SD in general, and CCM in particular, create a renewed need for detailed information about present and future environmental scenarios, as a base for

¹⁴ This section is based on article 4: Oliveira, R. V. (2020). A methodological framework for developing more just footprints: The contribution of footprints to environmental policies and justice. *Science and Engineering Ethics*, 26(1), 405-429.

establishing feasible targets and creating added benefits, as discussed in articles 1 and 2. Hence, the scientific and ethical communities are called to advance scientifically solid methods of understanding the state of environmental affairs and develop fair assessment tools. Environmental indicators are a key tool in that process, and resource and climate footprints are one important type of environmental indicator.

Article 4 (partially) addresses the implications of specific ethical principles-in this case, justice- not being considered enough in SD practices (sustainability assessment) (RQ III) and how applied ethics can contribute and shape those SD practices (RQ IV).

More specifically, article 4 tries to respond to (1) what is the importance of having fair(er) sustainability assessment tools?; (2) what ethical principles are necessary for the development of a more just framework for footprint calculation?; (3) which parameters and calculation framework could ensure a just distribution of environmental responsibility through footprints?; and (4) why footprints with justice concerns can be a tool for strengthening the influence of scientific information in developmental, global and distributive justice contexts?

In the fourth article, one of the key arguments is that environmental assessment – in this case, via the footprint method – influences environmental policies and societal actions. Another claim is that more just methods of assessing the state of resources and the environment have the potential to steer policies towards increased environmental justice.

The literature on the subject of footprints is mainly focalised on case-study application (Larsen, Pettersen, Solli, & Hertwich, 2013) and method development (Hertwich & Peters, 2009). There is some exploratory work on footprints and responsibility (Fuller, 2017) and there are a few studies on justice (Brandt-Rauf, 2010). However, there is not enough systematic work on the ethical implications of calculating and applying footprints, for example in policymaking.

My ambition in the fourth manuscript is to go even beyond the examination and exploration of the justice and policymaking implications of footprints and establish ethical principles for the development of a renewed framework i.e. establish a footprint calculation based on justice grounds. To accomplish that, I reflect in the article about what ethical principles could be adequate for the development of a more just calculation framework.

I assume a broad interpretation of environmental justice which integrates the distributive participatory, developmental and global justice facets. The ultimate objective is to make

footprints a morally sound tool in scenario building and to strengthen the influence of scientific information in justice debates. In other words, this ‘new’ footprint is tailored to provide (better) information for discussing and reflecting on moral dimensions of sustainability because it internalises dimensions of justice which are relevant for this context.

In the environmental justice debate, it is invaluable to know the state of affairs of resource use, emissions and their distribution. Footprints are an *ideal* tool for assessing resources, indicating the (national and regional) provenance of present (and future) emissions and pinpointing the agents responsible for those effects. In other terms, footprints attribute environmental (or social) impacts, emissions or resource consumption to economic activity.

However, footprints are neither morally neutral indicators nor used impartially in environmental discourse. They are powerful scientific instruments and policymaking tools. Their results are part of the justification for relevant environmental policies and they are also an important interface between scientists and politicians.

With the extensive and continuous application of footprints to justice debates, particular agents are often singled out as directly accountable for the source use and/or impacts, diverting attention from other possible actors. This creates additional environmental responsibility on footprints in power asymmetries that affect nations and societal groups.

Another relevant characteristic of footprints discussed in article 4 is that they are not all calculated in the same way¹⁵. In the field of Industrial Ecology, and in the context of input-output analysis, there are two types of calculation systems of footprints: production-based and consumption-based, which generate results that can differ a great deal. These differences can lead to contrary discourses about who (individually and collectively) should change and support actions to mitigate and prevent further environmental degradation.

In the mentioned article, I maintain that the application of the production-based footprint has created a significant political effect in the way nations are perceived, particularly because some countries may hardly (or ever) be able to achieve the international established environmental targets. Furthermore, I argue that the wide application of this method, in the national systems of environmental planning and assessment, leads to the rapid change in environmental impact profile of nations, mainly associated to ‘emission leakage’ (carbon).

¹⁵ The diversity of footprints and footprint calculation is further developed in the sub-chapter ‘Footprints: Tools for Justice’ but not specifically in article 4.

This phenomenon has relevant justice (and environmental) consequences. The delocalisation of heavy emitters generates negative (local and regional) social and economic effects, both in developing and developed countries. This situation deepens international developmental asymmetry and fuels environmental injustice.

In the manuscript, I also defend that the away consumption-based footprint is generally presented makes consumers be ultimate culprits for the totality of the environmental impacts of the goods and services i.e. the consumers are held environmentally responsible for the entire value chain impacts.

I further argue in the article that, like the production-based method, the consumption-based principle has several flawed presuppositions. In the last case, mainly associated with the method's underlining assumption of an *all almighty and knowledgeable* consumer who is totally free and capable of making the *right* choices. However, socio-economic and cultural conditions show otherwise. It is, therefore, reasonable to claim that it is unfair to centre the responsibility solely on the individual when significant factors are influencing the actions of consumers, like the structure of an economy based on profit or the intricacies of value chains.

In view of this, I assert that both consumers and producers should assume their environmental responsibilities since they both negatively affect the environment through their choices. In mathematical terms, it translates into the adoption of a shared production-consumption based accounting matrix for footprint calculation, where differentiated levels of environmental responsibility (coefficients) based on justice reasons.

In article 4, I propose a footprint framework (*just footprint*) that has the novelty of integrating the specificities of the agents in their national contexts, i.e. the *just allocation* of responsibility is calculated, in this case, according to specific characteristics of producers and consumers of each nation. In this way, there is an 'endogenisation' of justice principles at the design level.

The greatest strength of *just footprint* is to account not only for what the agents are using, impacting and emitting (like the *classical* footprint) but also what they are capable of, and willing to improve in their environmental performance, in real-life situations, which is the national context where they operate. The *willingness* to improve actions and choices is particularly important because it alludes to (a certain dimension of) responsibility, which is shaped by internal (e.g. individual beliefs, corporate cultures) and external factors (e.g. national context).

In sum, the *just footprint* is intended as an enhanced tool for environmental assessment and accountability, specially designed for promoting fairer SD transitions, as it includes differentiated coefficients of environmental responsibility. It aims at responding to the need for adequate quantitative environmental indicators for policies dependent on the *right* information. Moreover, it is an example of the necessary and accomplishable integration of scientific and humanities disciplines to overcome the multifaceted challenges of sustainability. The proposed (re-)design of a well-accepted environmental assessment tool to meet minimal justice standards also creates a unique chance of reinforcing policymaking based on scientific and moral foundations. The *just footprint* facilitates and expedites the use of scientific information, it sanctions the agents involved in the process, and above all, it legitimises the political process and its outcomes. Hopefully, this tool increases the chances for generalised acceptance of measures, even if they require additional effort from societal agents.

Ensuring the Well-being of Future Generations¹⁶

At the centre of SD lies the moral consideration of the interests and well-being of future generations. This fact is the motivation behind articles 5 and 3.

In general lines, they are about the harmonisation of ecological, sociological, and economic principles with the intergenerational justice framework, as a path to guarantee, at least minimal life conditions, to future people. Both are written in the same trajectory, having article 5 a focus on theoretical development and applicability to present developmental action, and article 3 focus on policy development.

The fifth and third articles (partially) try to respond the thesis RQs, particularly what frequently contributes to moral tensions in SD (policy-making) discourses and why?; (RQ I); what are some of the relevant commonly found moral principles in those discourses?; (RQ II); what are common consequences of competing moral principles in SD discourses?; (RQ IV); and how can applied ethics contribute and shape SD discourses and practices? (RQ V). This last RQ is the most relevant for article 3.

¹⁶ This section is based on articles 5 and 3: Vasconcellos Oliveira, R. (forthcoming). Justice with a future: Contributions from sustainability to Intergenerational Sufficiency; Vasconcellos Oliveira, R. (2018). Back to the Future: The potential of intergenerational justice for the achievement of the sustainable development goals. *Sustainability*, 10(2), 427.

Since the article 3 and 5 are different in design, each one will be dealt with in a sub-section, starting with later.

*Harmonising intergenerational sufficientarianism with strong sustainability*¹⁷

In the many ways SD theorists and researchers envision the future, what is and should be left to the generations is most of the times a source of great discussion. The question of what principles should orient the distribution of goods and burdens with the people to come is the specific theme of article 5. More precisely, I discuss in this manuscript (1) how and (2) why integrating Earth's limits in intergenerational justice debate is relevant to the well-being of future people?; and (3) what are some of the theoretical changes in intergenerational sufficientarianism due to the adoption of strong sustainability?.

In general, article 5 problematises the necessary relation between what can be considered fair to leave to future generations and the type of eco-socio-economic development society chooses or should choose to take.

On the contrary to the other articles, in this case, there is comprehensive literature on the subject which served as a conceptual skeleton for the development of this work. Manuscript 5 is based on some of the theoretical development of distributive justice theories (egalitarianism and sufficientarianism) concerning SD (Gosseries, 2005b) (Gaspart & Gosseries, 2007) (Gosseries, 2011) and future generation interests (Hendlin, 2014).

The novelty of the work resides in a more concrete focus on the implications of sustainability principles on intergenerational distributive justice frameworks. My objective is to understand how the interests of future generations are or can be affected by the (non-) acknowledgement of Earth's limits. Put differently, this article seeks to clarify some of the effects of the relatively recent sustainability concept of planetary boundaries in the context of the intergenerational justice debate. I also address the question of whether we have the necessary conceptual tools to devise what is fair for future generations under the premises of sustainability.

From the different approaches I could frame the question of what is just for generations to come, I choose, in this article, the sufficientarian view. The reasons are explained extensively in the article's text (and in article 3). In this sense, the fifth manuscript is a theoretical

¹⁷ This section is based on articles 5: Vasconcellos Oliveira, R. (forthcoming). Justice with a future: Contributions from sustainability to Intergenerational Sufficientarianism.

exploration of intergenerational sufficientarianism derived from the SDGs objective to grant good conditions for (present) and future people. As it happens with article 3, one of the goals is to make sufficientarianism a stronger framework for achieving just futures.

In article 5, I go further in-depth concerning the justice conditions necessary to guarantee the interests of future generations and advocate for the alignment of intergenerational sufficientarianism with strong sustainability.

In the fifth manuscript, I adopt a (simplified) three-dimensional approach to sustainability capitals: ecological, economic or social goods and services. Following Noël and O'Connor (1998) stance on sustainability capitals, I defend that there are areas where they do not overlap in their potential to enable human well-being or capabilities, which means the impossibility of replacement of some goods by others of a different kind. In other words, I argue for a strong sustainability paradigm.

Consequently, and since Earth has systemic limitations— planetary boundaries— intergenerational justice debate cannot bypass the full acknowledgement that some of Earth's physical boundaries are surpassed or close to being irreversibly disrupted.

This argument and others, in the same line as described in article 3, are the justification for my defence of sufficientarianism as good ethical framework for the conception of fair futures. However, I also sustain that sufficientarianism must address the implications of planetary boundaries to be coherent with some of its claims, which has not been done consistently so far.

To change this status, it is crucial to address the characteristics of intergenerational sufficientarianism which are (potentially) affected by a strong sustainability stance and by the planetary boundaries.

In any case, independently of the substantive nature of the currency of justice, well-being (or welfare, rights or capabilities) is directly influenced by the quality and quantity of capitals. Still, some of them are more crucial than others. The criticality of some of these goods —which, in this article, I define as *irreplaceable goods*— is dual: they are foundational to sufficient life-conditions, and they are significantly affected by present eco-socio-economic development. Simply put, *irreplaceable goods* are vital substrata for any human being in any generation and cannot be (fully) recovered to satisfactory levels if they fall below certain thresholds (or if planetary boundaries are overshot). This concept is a direct consequence of the adoption of a

strong stance on (environmental) sustainability but extends beyond the sphere of the natural capital. Besides elements like biodiversity and freshwater, *irreplaceable goods* also include social goods such as human rights or peace. The reason for inclusion is they are also fundamental for sufficient levels of well-being (or welfare, rights or capabilities). Although *irreplaceable goods* share similarities with critical resources, they are not the same, as *irreplaceable goods* include social goods and elements that are essential to conditions beyond basic needs (sufficient life conditions in any given generation)¹⁸. Since *irreplaceable goods* are essential for future people, I argue in the article that it is necessary to demarcate these elements within the sufficientarian theoretic framework. It is important to specify that in the case of *irreplaceable goods* as social enabling conditions, the distribution tends to be figurative, in the sense of creating conditions (e.g. via education) so to guarantee/foster certain thresholds (e.g. regulation on discrimination).

Due to the individualisation of *irreplaceable goods*, I support in the manuscript a moderate cleronomic¹⁹ version of intergenerational sufficientarianism, instead of its traditional non-cleronomic stance. In the paper, I advocate for the possibility of refraining from spending certain capitals if sufficiency is in question. In the case of the *irreplaceable goods*, I argue for saving and/or promoting the maintenance of the current level because of the low or impossible substitutability.

I comply with the traditional intergenerational sufficientarian notion of present generations' (possible) overexpenditure (*dissavings*) to the extent of not endangering future sufficiency. Nevertheless, and in the case of *irreplaceable goods*, even if its level is above sufficiency, it is still ethically justifiable to save them on account of a *precautionary* principle. Accounting for a certain degree of future uncertainty makes it sensible to consider investments for future generations as desirable (but not obligatory).

In article 5, I maintain that the inclusion of the investment and savings principle as above described, adds consistency to intergenerational sufficientarianism, which has the potential to enrich the discourse on fair sustainable transitions.

¹⁸ Critical resources are not a subset of irreplaceable goods because these elements do not have as a requirement to be necessary for sufficient life conditions in any given generation.

¹⁹ Cleronomic is a pattern of distribution of goods and burdens that depends on what each generation inherited from the preceding one. In this case, I support considering what each generation inherits from the previous one to establish the minimum required level for leaving to future people. For more, see Gosseries, A. (2016).

In sum, the harmonisation of sufficientarianism with SD principles, most predominantly the planetary boundaries, drives both frameworks further and enhances the applicability of fairness principles in practical political contexts. The translation of SD policies (e.g. SDGs, in article 3) in concrete strategies is one of the most challenging tasks of present times. However, by framing those strategies in a sufficientarian way, they might help to safeguard the well-being of future generations and to mitigate injustice in our contemporary societies. Of course, that for this to be a possibility, intergenerational sufficientarianism must respond coherently to the physical (and social) limits of our planet

Repositioning the well-being of future generations in the Sustainable Development Goals²⁰

As mentioned previously for CCM strategies with co-benefits, justice is a crucial value imbedded in discourses and practices. As documented in articles 1 and 2, policy documents offer a good window for understanding the ethical tensions and implications, especially concerning this value.

For this reason, I decided to analyse the SDG documents, since they are an emblematic example of ethical tensions and implications, and demonstrate the relevance of justice in the context of SD. Furthermore, I believe the analysis of ethical principles to guide the political translation of the goals and targets in concrete strategies and policies is much needed (in relation to the theoretical developments in article 5).

The specific RQs of article 3 are (1) what kind of justice principles are embodied in the SDGs' texts, concerning both near and distant future generations?; (2) how is it possible to protect the well-being of near and distant future generations while maintaining the integrity of the SDGs' targets and process?; and (3) what are the advantages of the reinforcement of the intergenerational sufficientarian justice framework in the SDGs?

Until the publication of this article, justice-themed researchers mainly explored limitations of single SDGs (O'Manique & Fourie, 2016) (Friedman & Gostin, 2016) or addressed their impacts for health (Friedman & Gostin, 2016) and global justice (Lueddeke, 2015) of the UN's SD targets. With article 3, I wanted to address the distributive aspect of SDGs which are clearly

²⁰ This section is based on articles 3: Vasconcellos Oliveira, R. (2018). Back to the Future: The potential of intergenerational justice for the achievement of the sustainable development goals. *Sustainability*, 10(2), 427.

understudied. The focal point is restricted to the intergenerational component of distributive justice, mainly because the UN establishes the interests of future generations as a pillar of SD.

The third article aims at uncovering the justice principles embodied in the SDG policy documents and at discussing how the lack of concrete intergenerational principles in SDGs affects their (short- and long-term) success. I also propose the reinforcement of a justice framework based on the attainment of minimal conditions as a way to protect the well-being of near and distant future generations.

Using content analysis (as articles 1 and 2), I uncover that SDGs are morally framed by the value of justice. More precisely, distributive justice. My analysis also reveals that just under half of the SDG targets have a maximum time horizon shorter than a decade and a half (2015-30). The SDGs' reduced timeline mostly promotes a more equal division of very minimal goods (e.g. education, maternal health) among genders and countries of origin.

Considering SD discourse and praxis, I claim that the SDGs' desideratum should be to foster fair socio-ecological conditions beyond 15 years, i.e. to consider more than the needs of the present and the *proximal* future generations. As they are written today, SDGs and their targets do not prevent or mitigate social and environmental injustice for (distant) future generations. Additionally, they do not acknowledge and respond to ascertainable potential contradictions in principles and actions taken to ensure the well-being of those future people.

The examination of the SDGs' supporting documents showed that, in terms of distributive justice principles, intergenerational egalitarian and prioritarian views are predominant but not unique. Overall, the SDGs adopt a 'pluralistic' distributive justice frame for present and proximal future generations.

Despite trying to ensure justice for present and (very) proximal future generations (maximum of 15 years), the SDGs miss out on the well-being of distant future people. However, this situation can be reversed by the development and integration of additional sub-targets (e.g. national, regional) for proximal and distant future generations. To do so, I propose in the third manuscript additional sub-targets designed under an intergenerational sufficientarian distributive justice framework for all 169 existing SDGs targets. Two thresholds are established for each SDG target, corresponding to the two-generational timeframes (proximal and distant future generations).

Besides the general reasons to support this described in the existing literature, I argue that intergenerational sufficientarian responds far better to the uncertainty of future scenarios (distant future generations) and regional eco-socio-economic specificities because it allows differentiated threshold(s) of well-being. I also maintain that it facilitates the translation of justice principles in SD criteria, i.e. it is possible to transform its axioms to practical parameters to be included in the assessment of the SDGs' targets. It is relatively straightforward to introduce and articulate minimum thresholds when contextualising (e.g. temporally, geographically) the majority of the SDGs' targets.

The implementation of intergenerational sufficientarianism for protecting and enhancing distant future generations' well-being can, de facto, facilitate decision- and strategy-making for SD and temporal justice frames – for example, by allowing evolving thresholds. This justice framework allows world targets and differentiated subsets of thresholds according to national and regional characteristics. The adoption of subsets of 'situational thresholds' has the added benefit of being a concrete answer to differentiated eco-socio-economic conditions, especially derived from past national rates of human development.

The arguments mentioned in support of a wider integration of intergenerational sufficientarianism in this context are independent of the content analysis findings on the SDGs' documents. However, considering them together, it gives additional backing to the idea of the feasibility of introducing 'sufficientarian thresholds' to the original targets, since the SDGs adopt a 'pluralistic' distributive justice frame, which (on a small scale) includes sufficientarianism principles. In other words, there are no evident relevant moral barriers in the analysed texts that would exclude a supplement of 'situational thresholds'.

Despite the positive aspects, the reinforcement of intergenerational sufficientarianism in the SDGs' discourse and practices does not come without challenges. Presumably, the most difficult one would be the establishment and acceptance of *basic* and *minimum* standards. This requirement would trigger additional international discussion among nations' representatives and stakeholders. It would be a much-needed occasion to involve not only researchers and politicians but also society at large.

On the overall, the SDGs 'pluralistic' distributional justice frame might work in favour of the introduction of 'sufficientarian thresholds' so to guarantee, at least, sufficient life conditions to distant future generations. As they are written now, SDGs only promote a more equal

distribution of minimal goods among present and proximal future generations, which falls short of SD ambitions.

Summary of Results

This section presents the most relevant findings of the five articles included in the thesis.

The research is built on the assumption that SD holds a heterogeneity in moral positionings and values, which can potentially facilitate dialogue and common action if there is a careful analysis of their implications. As stated previously, the general purposes of the work are to uncover and analyse some of those implications, and to identify the moral content and relevant values of particular SD discourses and practices. This section is therefore also dedicated to showing how these purposes were accomplished.

As all the articles show, there is little clear acknowledgement by SD agents in their written production that part of sustainability problems is of a moral nature. Even if (some) SD agents are aware of the ethical dimensions of SD, there is a prevalent (at least, rhetoric) choice to not explicitly include them in documents. The articles 1, 2 and 4 are particularly critical in establishing this tendency.

Looking at the example of CCM, it is possible to state that in what concerns co-benefits, used as an example of SD discourse and praxis, their enunciation and implementation lack a critical normative perspective. So far, researchers and policymakers tend to give small to no relevance to the ethical implications of the additional benefits from CCM. This fact generates a social negative effect, especially related to the well-being and rights of the worst-off.

The thesis articles also establish utilitarianism as being highly influential in SD. This importance goes beyond informing the *goodness* of actions or strategies to the conceptualisation of what is fair for present and future generations. Such reason for the hegemony is rebutted here by making evident the advantages of searching other moral frameworks, especially in view of social fairness and societal acceptability. For example, the first two articles suggest that utilitarianism does not account properly for SD benefits, especially if they are not (easily) translated into utility. Additionally, as also discussed in article 3, utilitarianism falls short on delivering justice to the most underprivileged groups when they are part of minorities, which happens to be the case in many real-life situations (e.g. Amazon indigenous communities in Brazil, mothers in developing nations).

To counteract the potential negative effect of co-benefits policies on deprived people, it is possible, to add other moral principles to CCM strategies already in place and re-direct, at least some the emerging co-benefits to these groups. By integrating human dignity and individual justice in CCM strategies and actions principles, it is possible to better assert and defend the rights of all people and most importantly, safeguard vulnerable socio-economic groups. However, it is possible to go beyond and include notions of well-being and freedom. They offer additional support for the moral evaluation of co-benefits and of the CCM actions that generate them. Their integration in CCM design and implementation also make room for the claims and well-being of those at the fringe of society without divesting from the rest of the population, i.e. including values of well-being and freedom in CCM actions creates improved conditions for a fairer and integrative SD.

As discussed through the example of co-benefits, deontology and CA have to offer SD relevant moral principles which are particularly relevant in the face of scientific uncertainty and social risk. Moreover, the moral diversity that societies holds requires an ethical reflection that covers the multiplicity of normative frameworks. Overlooking shared values and moral principles diminishes the ability to implement sustainability goals.

The articles on the theme of co-benefits also bring forward additional reasons for more bottom-up planning in CCM strategizing because doing so would increase citizen engagement in setting and meeting the targets for CCM.

Another emergent result from the analysis of co-benefits rationale, and also from the research on the well-being of future generations, is the necessity of co-creation of knowledge in the field of SD, especially concerning practical implementation. When different knowledge traditions come to the same arena, it is worth looking outside the traditional field boundaries and articulating frameworks. The totality of the articles attest to the necessary and fruitful interdisciplinarity in the SD but at the same time illustrate the associated challenges.

All five articles also reveal, on the axiological level, the prevalence of *justice* in SD's scientific and political discourses. In addition to *good* and *right*, *justice* and *fairness* shape the (policy and scientific) justifications for societal investment in SD.

Using the example of the SDGs it was possible to establish the inherent moral (and scientific) tensions in policy documents about SD, especially about the pathways to achieve present

sustainable development. Strains are also recognisable in the justification reasoning associated with the SDGs' recommended measures. At the centre of the tension lies the value of fairness.

Policy documents on SD, and in particular the SDGs, are a much-needed possibility for our generation to adopt a socio-economic development that promotes the value of well-being of present and future people. However, it is here demonstrated that, in the case of the SDGs, distant future generations' requirements are not minimally ensured by their current formulation. The SDGs opt for a short timeline for their targets which translates into the defence of intragenerational equality of minimal goods and services. Nevertheless, to truly embody SD, they should stimulate justice for all future generations.

To lessen the friction between the interests of different generations and lower the barriers for SD justification and implementation, additional SDG sub-targets are proposed, based on the principles of intergenerational sufficientarianism. Only by taking present action to safeguard well-being for all future people can SDGs live up to the task of helping to fill the gap in justice-seeking policy.

In any case, SD requires a societal investment that goes beyond the institutional level and extends to communities and individuals. In that respect, it is necessary to make sure that the analysis of the eco-socio-economic metabolism is done correctly. This research tries to reinforce the notion that the integration of normative concepts such as justice in the assessment of the current development can help in the consolidation of SD.

Most articles illustrate the role of scientific information in the construction of the SD narrative. Scientific knowledge has the power to defy or sustain policies with great socio-economic impact and critical justice implications.

Using the illustration of footprints, this research also shows that SD methodologies and tools influence the way human impact on the environment is perceived. Furthermore, it makes clear the influence of quantifying SD dimensions (in the form of environmental and social impacts), in the debates on environmental policies and justice. Given this importance, environmental indicators, like footprints, should be scientifically and morally sound instruments. Using the illustration of this environmental indicator, it becomes clear that contrary to current opinion, not all SD instruments are either morally neutral or fair. In the case of footprint, their stand on environmental responsibility is potentially harmful for policy purposes.

In response to this, the *just footprint* is proposed as a methodological framework that attempts to mitigate some of the shortcomings mentioned previously. It combines the most *just* scientific accounting process (shared producer-consumer method) with elements that concern agency, developmental, distributive and global justice. The reasoning behind it is dual and far more general: respond to a societal demand for fairness and reinforce policymaking based on scientific and moral grounds. The improvement of SD methods and practices creates better conditions for the legitimisation of the agents involved in the SD, the associated political processes and their outcomes. Hopefully, this improved tool is an example of what ‘justice-minded’ SD practices can boost the chances for generalised acceptance of sustainability measures, even if they have considerable societal (‘apparent’) costs.

From the analysis of this thesis, it is also possible to understand the potential benefits for SD to integrate theories which promote less commonly used principles or values. However, this effort may require additional changes in both SD and ethics theories. The example of articulating strong sustainability with intergenerational sufficientarianism shows how some of its principles are affected. The recognition of Earth’s limits requires among other things that present people consider very carefully their use of irreplaceable goods. To safeguard the sufficient life conditions for generations to come, SD strategies would make compulsory savings of irreplaceable goods since they are absolutely necessary for human life-conditions above a threshold and the present human development is jeopardising their level and quality.

In conclusion, this thesis attempted to make clearer some normative tensions on valuative-*good* and *right*-, and temporal - well-being of present and future generations - dimensions, which are recurrent in SD discourses and practices. It was established that preponderant ethical frameworks in SD, such as utilitarianism or egalitarianism, may fall short to grant justice to all individuals independently of their generation, causing additional barriers to its implementation. Additionally, this work tries to be a (modest) example of how applied ethics can shape SD discourses and practices so to ensure that well-being and freedom of present and future people is increasingly considered and guaranteed.

Thesis Limitations and Further Research

Any piece of research work has its constraints and in the case of this thesis, one of the greatest challenges was to make evident a common thread in the articles, due to the wide variety of analysed themes. However, to my understanding, this research stands as integrated coherent work instead of a collection of isolated articles.

It was a research goal to establish and characterise the moral tensions in different dimensions of SD. This thesis provides some pointers in this regard but does not include many other equally relevant dimensions. For instance, it does not cover all relevant agents involved in SD. For example, the economic agents were not analysed, despite having been (indirectly) acknowledged in some of the articles. The reasons were purely associated with time and effort constraints. Still, I believe the investigation of the economic dimension would have benefited the overall work, especially because it is one of the SD pillars and has crucial ramifications in the conception and implementation of SD strategies. Moreover, the well-established influence of applied ethics in economics and vice versa confirms the usefulness of an ethical perspective on the SD economic facet.

This thesis aimed at ethically evaluating practices, in the form of methods and strategies within SD. However, it has only covered one relevant method in SD (footprints) which is not enough for generalising conclusions about the ethical implications of scientific methodologies on SD. The same limitation is present in the analysis of the strategies. The SD actions analysed (e.g. subsidised e-vehicles) here are just a few and restricted to specific themes (e.g. co-benefits) and sectors (e.g. transportation). Considering the above-mentioned scope limitations, this thesis should be regarded as a stepping-stone towards a more comprehensive approach to SD examination.

Also, on general terms, the thesis promotes the bridging between fields in the area of sustainability. However, more could have been done on that account if the articles had been written with extensive collaboration. All other articles open doors to potentially relevant developments, especially if they were to be authored by a multidisciplinary team of researchers.

Considering the articles in detail, each manuscript has its weaknesses and at the same time, all works encourage additional research.

In the case of articles 1 and 2, it is debatable to what extent co-benefits design and implementation can mirror the suggested ethical principles, if appropriate additional socio-economic and political infrastructures are not already in place. Furthermore, these articles hint at the inherent justice dimensions of the proposed solutions for the moral improvement of co-benefits but do not explore this crucial aspect.

The third article would be more valuable if it included a reflection on how the present SDG framework tries to balance many different goals and key performance indicators. The disparity of the SDGs may lead to a risk of less focus on the strong sustainability aspects. Additionally, the SDGs do not clearly reflect the planetary boundary limits. These two characteristics have meaningful implications for intergenerational justice that have not been considered in the article. Article 5 tries partially to respond to the limitation above by providing some clues on how SD, in general, could be designed and implemented, if the interests of future people were to be guaranteed, under the strong sustainability paradigm.

In the case of article 4, it assumes the relevance of environmental indicators for assessing SD. However, this fact is debatable since the simplification of a complex reality dictates the loss of relevant information for establishing environmental responsibility. The scientific robustness and ethical value of the article are highly dependent on a sound translation of the socio-economic reality of nations and individuals in indicators, which are the mathematical parameters used in the calculation of the *just footprint*.

This thesis opens numerous doors for future research, especially because it is far from exhausting the proposed RQs and the overall aims, which ranged across an extensive spectrum of issues within sustainability and SD.

As future work from article 5, it would be interesting to establish what the consequences would be for SDGs in general, as well as for each SDG and its key performance indicators.

As for future work for article 4, the most appropriate step would be a full implementation of the model. By calculating the nations' *just footprint*, it would be possible to better grasp the current situation in terms of (e.g. carbon) emissions and develop policy guidelines aimed at improving (individual and collective) capacity for environmental improvement.

In any case, it is not apparent that the mentioned limitations and the benefits of researching further jeopardise the overall value of the thesis and the validity of its conclusions.

Conclusions

The thesis' hypothesis states that despite SD integrating great diversity in agents, discourses and practices, there might be common moral denominators (values and frameworks) that can help SD implementation. The overall articles support this hypothesis. It was indeed established that certain values (e.g. justice, well-being, freedom) and ethical theories are commonly embedded (e.g. utilitarianism, egalitarianism) in SD discourses and praxis. However, the research also showed that the widespread acceptance of such values and ethical theories may also be a hindrance if there is not a careful search for unwanted implications (e.g. disregard of the well-being of minorities or future people).

Another important implication of having a poll of shared values and moral principles is that SD agents might be reluctant to pursue the research and application of other or even less prominent values and moral theories, just to prevent additional sources of potential conflict. This research hopes to counteract this possible inclination by showing promising outcomes for SD when researchers and policymakers who look outside the more acknowledged theories and practices.

Additionally, it is possible to conclude that, if we individually and collectively keep on reflecting on these values and ethical frameworks, there is an increased chance for theoretical and practical amelioration, and most importantly there is an increased likelihood of responding better to evolving challenges of SD.

This thesis equally demonstrates that a challenge as complex as SD requires the integration of knowledge and methods from different disciplines using a synthesis of approaches. As a conclusion, it is also possible to argue that a similar approach can apply to the ethical analysis of SD. Accordingly, this thesis intends to embody interdisciplinarity through the articulation between contrasting academic disciplines and research methods with the ambition of contributing to the creation of a *new* ethical discipline: *sustainability ethics*. Hopefully, this thesis contributes to the pursuit of conceptual and methodological individualisation of sustainability ethics, which can in turn better contribute a true 'transdisciplinary sustainability'. A branch of applied ethics dedicated to SD and sustainability can aid in the generation and application of participatory conditions in the realm of this research. Certainly, this task of emancipating sustainability ethics from the realm of applied ethics comes with hazards as

demonstrated in this body of work. Still, it may allow the space and opportunity for analysing the ethical dimensions the relation of human beings with three-dimensions of sustainability.

In this way, and hopefully through this work too, (sustainability) ethics can further sustainability as a discipline that involves academics and laypeople in the pursuit of the common goal of a balanced and well-functioning human civilisation.

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Appendices

Paper I

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The Potential Of Co-Benefits In Climate Change Mitigation Strategy: An opportunity for Environmental and Social Justice

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Paper II

Ethical implications of a co-benefits rationale within climate change mitigation strategy

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The climate change mitigation effort is being translated into several actions and discourses that make collateral benefits and their rationale increasingly relevant for sustainability, in such a way that they are now a constant part of the political agenda. Taking a broader and consensual perspective, co-benefits are considered here to be emerging advantages of implementing measures to lower greenhouse gases.

Starting with the analysis of policy documents referring to two European urban transportation strategies, the emergent co-benefits are problematized and discussed to better understand their moral aspect. Further ethical reflection is conducted after an analysis of some unintended consequences of the co-benefits rationale arising from the examples. The discussion focuses primarily on the challenges of an integrative moral justification for co-benefits and also for their role in the climate change mitigation effort. We also discuss the limitations of the current normative models that frame a co-benefits rationale, both from a moral viewpoint and in relation to the overall climate change mitigation strategy.

In this article, we propose the concepts of well-being and freedom, as portrayed by the Capability Approach, as possible guiding notions for the moral and social evaluation of goodness of these emergent benefits as well as their rationale. Additionally, some preliminary conclusions are drawn regarding the potential of the presented concepts to support climate change mitigation action. Finally, we outline a scenario where the Capability Approach is the moral guideline for a co-benefits rationale and illustrates its potential in terms of enhancing climate change mitigation strategy.

Keywords: Co-benefits, Climate Change, Capabilities Approach, Freedom, Well-being

Introduction

Climate change mitigation refers generally to actions targeting the reduction and/or prevention of anthropogenic greenhouse gas (GHG) emissions. Analyses focused on how to accomplish this goal are directed at human activities that are responsible for global warming effects and at actions that may alleviate changes in the global climate pattern. Scientific studies show that to reduce human impacts on the global climate, the use of new and requalified technologies is needed, along with

a considerable increase in the use of renewable energy sources (IPCC 2013). Moreover, incremental energy and resource efficiencies, in addition to changes in management and behaviour patterns, are also relevant contributors to mitigation efforts.

The implementation of climate change mitigation (CCM) projects through the years has provided more information beyond pre-existing theoretical knowledge, adding to our topics for study and reflection. The additional beneficial consequences arising from the application of certain options to decrease GHG, generally known as co-benefits, constitute one of these topics. A co-benefits approach is a broad concept that, in the case of this paper, refers to 'the emerging advantages of the implementation of measures regarding the lowering of GHG' (Vasconcellos Oliveira, Thorseth, & Brattebø 2016). According to Selvakkumaran & Limmeechokchai (2013), co-benefits are mutually beneficial interactions, in terms of energy conservation and pollution reduction, that stem from the decrease of GHG emissions. They also include the reduction of resource depletion (Jackson and others 2005) and of emissions to air, water and soil as a result of changes in agricultural procedures (Follet & Reed 2010).

Due to the nature of the environmental problem, there are multiple areas for CCM action. Many contexts for CCM plans and actions exist, but urban settings have been and still are privileged scenarios of green policies and technologies. The reasons for this are multidimensional and complex (C40Cities 2012; UNHabitat 2012). Nevertheless, it is possible to identify a particular sort of governance as one of the important aspects (Corfee-Morlot and others 2009). A special combination of socio-economic and political aspects favours the implementation of what we might consider bold measures in CCM strategy (McEvoy, Lindley, & Handley 2006; Tanner, Mitchell, Polack, & Guenther 2009). These factors make the analysis of this phenomenon in this particular context especially interesting.

Though scientists (Creutzig & He 2009; Harlan & Ruddell 2011; Jack & Kinney 2010) and policymakers (IPCC 2007a) have engaged extensively in the analysis of co-benefits and their rationale, there is still room, and above all a need, for philosophers to address such matters. The moral implications and ethical reflection on co-benefits issues have not yet been analysed under a philosophical lens. Co-benefits and their rationale have been addressed mostly in terms of quantification, especially through models (Singh, Stromman, & Hertwich 2012) and cost-benefit analysis (Jakob 2006), and via assessment of particular initiatives (Aunan, Fang, Vennemo, Oye, & Seip 2004; Changhong, Bingyan, Qingyan, Green, & Streets 2006). The discussion around co-benefits phenomena to date has been centred on demonstrating that the additional advantages of implementing particular CCM strategies can surpass, or at least decrease the investment in, mitigation actions (Ganten, Haines, & Souhami 2010). Nevertheless, other questions on this matter have yet to be considered, such as: How can one morally justify the outcomes of technological options, recommendations and political actions that impact the lives of so many people, and especially of underprivileged groups? How should one deal with value conflicts of CCM strategies that have co-benefits? What is the decision-making process when there are trade-offs between co-benefits?

The goal of this paper, through consideration of these questions, is to contribute to further reflection on moral consequences and dilemmas that arise from climate mitigation actions, in cases where the co-benefits rationale exerts a clear influence.

By putting forward moral arguments and using ethical reasoning in relation to a specific context (urban) and with a few examples, we intend to enrich the global discussion on the consequences of climate change strategies. By adding arguments of a moral nature, we hope that more agents with environmental responsibilities will become aware of the ethical implications of their recommendations and options.

More specifically, the aims of this article are (1) to problematize the moral aspect of co-benefits, (2) to give an overview of different arguments that sustain co-benefits as moral object, (3) to reflect about consequences and dilemmas arising from a co-benefits approach and its rationale, (4) to put forward new arguments for the moral justification of this phenomenon within the CCM debate, (5) to draw some conclusions with respect to the strengths and limitations of this approach as a moral promoter of CCM action and (6) to show the potential of the Capability Approach when applied to a co-benefits rationale to enhance CCM strategy.

The paper is organized into three parts. The starting point of our analysis is a comparison between two iconic political initiatives on urban transportation undertaken in Europe. Since these strategies were highly influenced by the co-benefits rationale, we reflect on the objectives and values behind these actions. The concept of co-benefits is then defined to stress the moral dimension of this term. This part deals more closely with the moral angle of a co-benefits rationale that is subjacent to both aforementioned initiatives. The second part also includes a discussion on how to morally justify a co-benefits rationale within the CCM debate, beyond the traditional argumentation presented in literature. A co-benefits rationale is problematized around the concepts of well-being and freedom, and finally some conclusions are drawn about co-benefits rationale as a strategy to instigate climate change mitigation actions.

Climate change mitigation strategies in an urban context

More than half the world's population presently lives in cities (UN 2014), and by 2050, the urban population is predicted to exceed 6.4 billion (WHO 2010). Urban settlements are responsible for 67–76% of energy use and 71–76% of energy-related greenhouse gas emissions (Christ 2014), which means that cities are key players in mitigation strategies.

Many cities are presently trying to break out of the vicious cycle of energy- and carbon-intensive development (C40Cities 2015b), which results in higher energy costs and carbon emissions, as well as traffic congestion, air pollution, poor public health and a range of other negative impacts (Kalkstein 1993).

Despite the aforementioned problems, cities are growing every year. The reasons for urban growth are the facilitated access to people, goods, services and information. The degree of this access efficiency dictates the level of development, especially economic development (Combes, Duranton, Gobillon, Puga, & Roux 2012). The increase in agglomeration allows high levels of productivity and the possibility of successful economies of scale and improved networking (Krugman 1993). This type of reality is only possible if the urban transportation system guarantees the fluxes of people, goods and information (Vuchic 1999).

Since the dawn of urban areas, transportation has been vital to the flourishing of any city, and this dependence is now stronger than ever. According to van Van Audenhove, Korniihuk, Dauby, and Pourbaix (2014), urban travel currently

constitutes more than 60 per cent of all kilometres travelled globally and, as a result, urban transport is presently the largest single source of global transport-related carbon emissions and the largest local source of urban air pollution.

Urban kilometres travelled will increase threefold by 2050 (Van Audenhove and others 2014) due to urban expansion. Such unprecedented change will bring with it enormous risks associated with locking in energy-intensive patterns of accessibility and urban form for decades to come (Ang 2013).

In this context, several urban mobility strategic plans are being developed at international¹, national² and regional³ levels. All the initiatives share the overarching goal of reducing GHG emissions, but the measures being implemented are quite different.

At the start of the C40 Cities initiative, only a few European cities were involved. Now, more cities overall, including non-European ones, are participating. In the case of this paper, we will analyse two structurally different CCM actions in the urban European context.

Invest in Public or Private Benefit: Two Dissimilar GHG Mitigation Strategies

City of Hasselt: 'Free Public Transportation' initiative

One of the most radical approaches to 'greener' urban mobility took place in the city of Hasselt in Belgium. *Hasselt Samen Anders Mobiel* was the name of the programme designed to take '[...] measures that will add years to our life and add life to our years'⁴. It was an ambitious programme that covered several aspects of the city's mobility and became famous for its 'Free Public Transportation' initiative. The intention was 'to convince its population and visitors, by means of targeted marketing campaigns and an ongoing dialogue, that to travel in an eco-friendly way is better and more convenient than by car' (Lambrechts 2001: 1).

The reasons to set up such an initiative were that 'Hasselt is the capital, commercial core and education centre of the province of Limburg in the eastern part of the Belgian region of Flanders. [...] Until the early 1990s, the city's public transport system was quite underdeveloped and car density was the highest in Flanders at 467 cars per 1000 inhabitants' (Brand 2008: 183).

The initiative consisted in having unrestricted public transportation because 'the city council pays for each ticket that a passenger would normally buy' (Lambrechts 2001: 14).

This approach was considered revolutionary, and similar initiatives were implemented in other cities such as Tallinn (Galey 2014) and Brussels (De Witte and others 2006). Nevertheless, in 2013 the Hasselt initiative was terminated, apparently due to the excessive and continuous rise of costs (Canters 2014).

It is relevant to mention that this was not the first instance of public investment in the improvement of urban public transportation (Dave 2014; Flyvbjerg, Skamris Holm, & Buhl 2005). However, never before had a programme existed that made the use of public transportation free of charge for all city residents and visitors. Another relevant aspect of this initiative was the primary focus on general benefits that went above and beyond GHG mitigation. The main reasons for this programme⁵ were, among others, traffic safety, parking policy and increasing alternative solutions to car mobility (bikes and public transportation). These

particularities made this initiative quite unique and a model for urban mobility planning.

Norwegian cities: The boost in usage of private electric vehicles

Norwegian cities have adopted far different plans than Hasselt did in order to achieve Norway's ambitious sustainability targets. In the case of the capital Oslo, the objectives are to reduce its greenhouse gas emissions by 50 per cent by 2030 as compared to 1991, and by 2050 to be climate neutral (Pas 2014).

In 2008, it was decided to start significantly reducing CO₂ emissions, and since weather conditions during the winter months were not favourable for cycling, Oslo decided to promote electric vehicle (EV) usage. The Agency for Urban Environment and the EV community developed a plan to establish a large-scale EV charging point installation. It is important to make clear that 'Oslo's mobility strategy is found in its wider "Urban Ecology Programme 2011-2026" plan, which focuses on reducing noise levels, air pollution and greenhouse gases' (Pas 2014)⁶. It is relevant to understand that 'the city believes that the social benefits, such as reductions in harmful emissions, outweigh the costs of expanding the existing charging infrastructure and the transition to an electric vehicle fleet' (Pas 2014: 1).

In a similar move, the city of Stavanger has 'implemented the necessary infrastructure for private electric cars. The city has taken part in the EU project - ELCIDIS - in order to implement an electric vehicle city distribution system which has involved a review, of urban-freight in Stavanger and a replacement of goods vehicles with electrically powered vehicles' (Eltis 2008).

In some cities such as Trondheim, EVs were also promoted as public transportation through a joint collaboration between taxi operators, utility companies and the municipality (EV Norway 2012).

In the case of the Norwegian commitment to increase the number of EVs on their roads, it is important to note that the public investment promotes both the acquisition of private property (cars) and the usage of these vehicles (EV charging points). The programme objectives extend far beyond decreasing greenhouse gases and include other beneficial outcomes such as pollution reduction that have become increasingly more important (Holtmark 2012).

Different paths with similar goals

From the examination of these examples it is possible to draw some preliminary conclusions regarding the fundamental reasons for and objectives of such initiatives. Both examples included a goal directly related to the decrease of urban GHG emissions, and the initiatives' specific targets were in accordance with a more global policy framework, which was adapted from national guidelines to regional contexts. Moreover, in both cases public money was invested through governmental or public institutions that are under public scrutiny.

The programmes in both cities were tailored to abide by national policies, and the national policies are illustrative of the principles of international regulation on CC.

Another shared and very significant aspect of these initiatives was the existence of explicit aims in addition to the lowering of GHG. The overarching programmes and the initiatives both focused mainly on outcomes such as pollution mitigation or traffic reduction. In other words, the additional benefits, and not the mitigation of

CC, were the main reasons to implement the initiatives presented in the policy documents.

In the case of the Belgian city, the sustaining arguments centred on improving citizen circulation.

‘The Hasselt mobility plan has 11 main objectives aimed at achieving sustainable mobility: 1. Increase traffic safety; 2. Directional parking policy [...] 1. To create a car-free city centre for pedestrians; 2. To encourage the use of public transport for city tours from different areas within the region [...]’ (Lambrechts 2001: 6-8).

The Norwegian Ministry of Transport and Communications developed Norway’s favourable policy on EVs, which to some extent included environmental arguments (Hannisdahl, Malvik, & Wensaas 2013).

‘This combined incentive saves BEV (ongoing battery electric vehicles) commuters’ money and significant amounts of time, while reducing noise and local pollution to the benefit of the public at large. (Hannisdahl and others 2013: 3).

In both examples, CCM was secondary in relation to other gains, which is thought provoking as a justification argument for public investment. This apparent inversion in level of importance adds a relevant point for reflection about the possibility of co-benefits overshadowing CCM in their rationale. Furthermore, the question arises whether the policymakers thought that CCM on its own would not be a sufficient argument for public investment.

The hidden (co-) benefits and their moral dimension

Pragmatic reasons

In the course of rationalizing and applying CCM strategies, some scholars uncovered additional positive effects that go hand-in-hand with reducing emissions of CO₂ and other greenhouse gases. The urban transportation cases previously analysed in this paper are two examples of situations where further benefits emerged.

In the field of environmental sciences, different institutions and organisations have different understandings, definitions and interpretations of these additional advantages, or co-benefits. According to the Organisation for Economic Co-operation and Development (OECD 2014), ‘for GHG mitigation policies, co-benefits can best be defined as effects that are additional to direct reductions of GHG and impacts of climate change and have estimated to be large, relative to the costs of mitigation (e.g. anywhere from 30% to over 100% of abatement costs)’. Additionally, they are ‘(monetised) effects that are taken into consideration as an explicit (or intentional) part of the development of GHG mitigation policies’ (Jochem & Madlener 2003: 6). The Intergovernmental Panel on Climate Change (IPCC 2007b: 22) considers them to be ‘benefits of policies that are implemented for various reasons at the same time—including climate change mitigation—acknowledging that most policies designed to address greenhouse gas mitigation also have other, often at least equally important rationales (e.g. related to objectives of development, sustainability, and equity)’.

From a more general perspective, and in this paper, co-benefits are defined as mutual beneficial interactions that arise from decreasing anthropogenic GHG emissions, or in other words, co-benefits are considered to be emerging positive advantages of CCM action. For example, in the area of energy conservation, pollution reduction—especially gaseous pollution (West and others 2013)—is considered a co-benefit.

More recently, the concept seems to anchor further perspectives such as climate co-benefits, climate and air co-impacts (Nemet, Holloway, & Meier 2010). This multiple understanding of co-benefits extends itself to the diversity of methods and tools for assessing co-benefits (K. R. Smith & Haigler 2008).

It is relevant to mention what is known as development co-benefits in a regional context, which are improvements in a local setting due to the implementation of climate change policies. Examples of those benefits are improved air quality or cleaner technologies that will create better jobs in a specific region (Miyatsuka & Zusman 2010).

Climate co-benefits also include global climate change benefits coming from the implementation of plans or sectorial policies and actions. This notion has evolved from the idea that developing countries would focus on the development of their economies before having environmental concerns (Miyatsuka & Zusman 2010).

The following table describes some of the ideas behind the use of the term ‘co-benefit’ in a climate change mitigation context:

Impact level	Category of co-benefit	Description
Global	GHG Emissions reduction	GHG emissions reduced mainly through cutting fossil fuel consumption and improving energy efficiency
Local	Air quality improvement	Reduction of pollutants, such as SO ₂ , NO _x , PM, CO.
	Waste management	Reduced use of primary materials; reduction of hazardous waste, waste materials; and reduced waste disposal costs.
	Water quality improvement	Reduction of pollutants in water. GHG emissions (e.g. CO ₂ , CH ₄) are also reduced in the process of water quality improvement.
	Production	Improved product quality or purity; reduced process cycle times; increased production reliability; increased customer satisfaction.
	Health	Reduced medical/hospital visits, reduced lost working days, reduced acute and chronic respiratory symptoms, reduced asthma attacks, increased life expectancy.
	Economic	Increase in local GDP and employment rate. Improved welfare.
Other		Improving the working environment (e.g. improved lighting, temperature control and air quality; reduced noise levels; reduced need for personal protective equipment; increased worker safety.)

Table 1: General aspects of the co-benefit term in sustainable development discourse. Adapted and expanded from Jiang and others (2013).

Some of these additional benefits are found at a regional level and are thus more visible and relevant for communities, such as more green jobs in clean energy production (Yi 2013), while others have a global effect, such as the improvement of air quality (West and others 2013).

The moral side to co-benefits

Taking a closer look at the initiatives described, it is possible to uncover several additional advantageous consequences to lowering GHG. Both initiatives were designed to create specific co-benefits (e.g. decreased traffic noise, improved mobility), which were cited as being the major objectives. In other words, they were designed under a co-benefits rationale and not solely for the purpose of fighting climate change. The political option of presenting only CCM as the orienting idea and justifying argument would also be possible, since the European Union has legislation and climate targets (Pew Center 2009) that would suffice for the development and validation of both initiatives. However, this 'CCM rationale' was not chosen by these policymakers, who preferred a co-benefits approach as the guideline and as the means for public validation.

In both initiatives, co-benefits were publicly presented as valid reasons for implementing these GHG-lowering emissions strategies. This co-benefits rationale is also found in other CCM general strategies and initiatives (Nemet, Holloway, & Meier 2010).

These examples create an additional opportunity for further reflection about the adequacy and suitability of a co-benefits rationale.

The general literature on co-benefits⁷ consistently states facts and numbers that have created a shared belief, especially present in policy documents, that co-benefits are good and desirable (Aunan, Fang, Vennemo, Oye, & Seip 2004; Creutzig & He 2009). The article 'Counting good: quantifying the co-benefits of improved efficiency in buildings' from Ürge-Vorsatz, Novikova, & Sharmina (2009) is a striking example of how the environmental sciences view co-benefits and how they justify their rationale.

Besides the scientific evidence for a potential good, the idea of co-benefits itself holds a latent notion of some kind of rightness. The concept of 'benefit' carries a positive emphasis that can be analysed under a normative perspective. Moreover, it also points to an evaluative setting, meaning that an ethical side must be accounted for. In addition to these factors, there is a societal shared belief about the emergent outcomes of CCM that deserves to be philosophically analysed under a moral scope.

Through the examples mentioned above, we shall consider the possibility of moral justification for co-benefits and their rationale.

Hasselt's and Oslo's urban transportation initiatives: the influence of a co-benefits rationale

Both CCM literature and related policy documents (WHO 2012; Ürge-Vorsatz and others 2009) enable us to establish that a co-benefits rationale encompasses two different notions. Firstly, co-benefits are used to support acceptance of and compliance with policies and regulations aiming at CCM, in what could be called, on the one hand, a rhetorical-persuasive use. At the same time, there is another dimension that can be called an ethico-economic use. Here, co-benefits are part of an attempt to weigh and assess the justifiability of mitigation policies and

regulations, i.e. to answer the question: ‘Are CCM policies worth the sacrifices and costs they require?’.

The cases of the Belgian ‘Free Public Transportation’ initiative and the Norwegian boost of private electric vehicle usage policies are strong examples of these notions.

The Hasselt initiative, created just before the new millennium, was driven by specific ideas about urban mobility development within a context of sustainable development. As Lambrechts (2001: 29) states, ‘all the measures [...] should make Hasselt a city with a sustainable quality of life. A city that takes future generations into consideration’.

On the grounds of the rhetorical-persuasive use of a co-benefits rationale, the text below alludes to a possible deontological framework that would confer additional normative strength to the argumentation in favour of the initiative.

‘By making public transport free of charge it became possible to guarantee the right to mobility for all residents. The threshold was laid so low in fact that each and everyone was able to enjoy their right to mobility’ (Lambrechts 2001: 13).

Nevertheless, in order for such arguments to have true deontological weight (in the sense of an ethico-economic use), specific requirements need to be met. One possibility is the conformity to established moral rules based on duties and obligations that can, in some cases, be translated into rights. In our specific cases, and in the analysed documents, there is a line of argumentation that tries to justify the subsidization of public transportation and of electric vehicles based on some type of moral obligation of the authorities to guarantee a supposed right.

Though it might be appealing to use the term *right* as a means of political and social justification, first one must be theoretically sure that the concept and the necessary deontological matrix can be applied to both the specific (e.g. mobility, sustainable community) and the general co-benefits.

In the case of Hasselt’s initiative, mobility is presented as an established social right, granted to all citizens, regardless of their background or economic condition. In general, countries recognize the right of their citizens to travel and move within their countries and abroad—with varying restrictions—in their constitutions or general laws.

Nevertheless, considering Hasselt’s example, the word *right* relates here to further entitlements than just the possibility of freedom of movement *sensu stricto*⁸, which is the meaning present in the Human Rights Declaration and ‘deontological’ literature (IOM & UNDESA 2012).

In our example, mobility refers to a good or adequate way for people to move. Confirming this hypothesis, Lambrechts (2001: 2) describes that ‘we have seen a shift from mobility to sustainable mobility. [...] Sustainable mobility policy stands for the development of a form of mobility that takes into account the needs of the current generation without endangering the mobility needs of the future generation’.

This perspective of extended mobility is shared by other cities (Díaz & Paez n.d.) and governments (Cresswell 2006), especially when it comes to attaining sustainable mobility (Van Neste & Sénécal 2015).

Although the moral justification of mobility *sensu stricto*, from a deontological perspective⁹, may not cause an uproar, the response is different when a more

integrative definition¹⁰ is examined. A concept of mobility that integrates sustainable considerations brings more controversy to the table. For example, a right to sustainable mobility includes some consideration of future generations, which is still at the core of many fiery debates (Boyle 2006; de Sousa Santos 1999).

Other sources of questions and obstacles to a clear validation of the right to sustainable mobility stem from this possible right: Should the right to sustainable mobility be considered under the umbrella of environmental rights? Or simply as an extension of human additive goods?

A possible 'right to mobility' has a strict relationship to a narrower anthropocentric perspective, where the achievement of a condition will allow the agent to increase his or her possibilities of self-fulfilment and/or his or her capacities for particular actions. On the other hand, a right to a 'sustainable mobility' has to measure up to at least certain environmental aspects that are completely missing in the previous right. Even without regarding what sustainability might mean in such a context, it always includes natural systems, even if in a subordinate relationship to the human one. Consequently, from a moral viewpoint, considerations on what might constitute a 'healthy and flourishing environment' or 'general satisfactory environment favourable to [people's] development' (Boyle 2006: 33) must be weighed against the obligation to promote mobility. This possible conflict is exacerbated in the Hasselt example, since the aim of that policy was to put people at the centre of the considerations. The need to consider other aspects, such as the environment, makes the trade-offs even more difficult.

However, in the general context of this particular co-benefit, the inclusion of the environment appears to be mandatory because it is part of a greater strategy to address climate change, and yet policy and societal discourse do not fully recognise this assertion.

Comparable questions and points of dispute arise when we read the policy texts referring to Oslo's initiative to boost private electric vehicle usage.

'The city (Oslo), which currently holds the record for the European continent's smallest per capita carbon footprint, aims to be a sustainable urban community where everyone has a right to clean air, clean water and access to attractive outdoor recreation areas' (Røsland 2013: 2).

The words of Stian Røsland, mayor of Norway's capital, clearly express a normative aspect of collateral benefits coming from Oslo's sustainability plan, which includes the electric car initiative. In the same vein as the Belgian politicians in Hasselt, Røsland emphasises the importance of climate change actions to promote citizens' rights. However, in this case the considered right is not directly connected to mobility but to good natural resource quality.

In the case of water, the right to this resource has already been recognised both morally and legally (Gleick 1998; OHCHR, UNHabitat, & WHO 2010; Salman & McInerney-Lankford 2004). As for air, there is no international legal statement about a specific human right to it, but the quest to assure access to clean air for everyone, in the sense of air free of pollutants, has been acknowledged internationally via the UN (CCAC 2015).

The possible right to a sustainable community has not yet been clearly stated as a legal or moral right. However, several institutions are lobbying to 'build sustainable communities by assisting people to assert their right to local self-government and the rights of nature' (CELDf n.d.: 1).

Despite the effort to establish a deontological normative-oriented argumentation, a second look at the explanatory texts of both initiatives unveils another, probably even more relevant, moral guideline. In both cases, the outcomes of the CCM initiatives (sustainable mobility, clean air and water and attractive outdoor recreation areas) are the real ‘moral compasses’ for the evaluation and consequent justification of the strategies. Throughout co-benefits literature (Vasconcellos Oliveira and others 2016) and also in CCM strategizing (Dietz & Asheim 2012), the consequentialist moral frame has so far predominated, and these particular examples seem to incorporate their influences.

All documents emphasise the positive outcomes but not the principle of acting to mitigate GHG emissions¹¹. Interestingly, the desired consequences, which are portrayed as *rights* in both documents, are themselves good consequences that should be extended due to their perceived relevance. The use of public transportation (Hasselt) or electric private vehicles (Oslo) are means of guaranteeing that more people (i.e. ‘all citizens’) have access to more *good* (e.g. ‘mobility, clean air and water’). In the documents, the collective perspective has a special prominence, as in any utilitarian reasoning, since it is the action of more citizens that creates the existence of the benefit and the possible extension of it.

The analysis of both Hasselt and Oslo urban transportation initiatives shows a ‘hybrid’ use of moral arguments and reasoning. In these two cases, the co-benefits rationale, in terms of ethico-economic use, is infused by a utilitarian approach, but at the same time, it also integrates deontological jargon and some deontological influences. The use of a ‘rights terminology’ aims at reinforcing moral power in an attempt to rhetorically legitimize the strategies. The use of both moral traditions likewise expresses the realization by the policymakers of the difficulty, and the necessity, of finding a coherent and inclusive moral framework for co-benefits.

In summary, the justification of co-benefits and their rationale through a rights (moral and legal) perspective, both in general cases and in particular cases (e.g. water, air), is achievable without major effort. Society (legal rights) and ethicists (moral rights) have already established a set of arguments and a type of reasoning in favour of recognising these co-benefits as rights, and these reasons are not being challenged or contested.

However, the overall strength of the argumentation would not be enough to establish other types of co-benefits (e.g. sustainable community and mobility) as moral and/or legal rights, despite the existence of some potentially favourable arguments, such as welfare. In addition, the lack of a solid basis favouring the recognition of these co-benefits as rights opens the door to counter the overall justification (e.g. hierarchy of importance within rights), if a deontological approach were to shape the rationale.

When collateral benefits cannot be regarded as basic, inalienable rights or as relevant for human dignity, but instead provide some degree of good or well-being, or are interests¹², they are worth being morally justified. As mentioned before, not all co-benefits have the characteristics to be considered under the dimensions of moral and/or legal rights (Rea 1986). However, co-benefits can still be considered claims (e.g. access to attractive outdoor recreation areas) or responsibilities (e.g. mobility that takes into account the needs of the current generation). When this is the case, they—and by extension the argumentation around them—deserve to be

morally analysed, in order to understand of the possibility of a plausible justification.

Another possibility for justification would be to address co-benefits from a perspective of utilitarian goods, which is in line with the rest of climate change policy.

So far, utilitarianism has been the best-known form of consequentialism and has deeply influenced not only ethical thought but also political and economic theories. More recently, utilitarianism has entered the environmental arena.

There are several variants of utilitarianism; however, they all focus on the 'quality of the consequences'. The ruling principles are the following:

'If and only if the consequences of a particular act would be worse than those of some alternative, then it would be wrong for that act to be performed. [...] If and only if the consequences of everyone's doing a certain sort of thing would be worse than those of some alternative, then it would be wrong for anyone to do such a thing.' (Feinberg 1967: 369)

Defined more broadly and simply, utilitarianism holds that each individual is morally required to act in such a way as to produce the most good. The classical utilitarians (e.g. Bentham, Mill or Sidgwick) regard good in terms of pleasure, pain or happiness. This perspective evolved and became more pluralist, for example including other values such as beauty (Crisp 2013), potential Pareto improvements, wealth or even GNP (Sagoff 1986).

More recently, in response to criticism from deontological ethicists, the objective of a good action has become more nuanced. For example, the utilitarian author Jamieson considers the objective of utilitarian action as the creation of the best outcomes, here perceived as well-being (O'Brien, Clair, & Kristoffersen 2010). It is important to bear in mind that, independently of the utilitarianism version, one's own well-being has the same value as others' well-being.

Furthermore, there is an obligation towards maximizing the overall good. In other words, maximizing the overall net benefit, often referred to as aggregate well-being or welfare, is the goal. Utilitarians 'calculate' aggregated welfare by assessing the benefit or harm to each individual, and then adding all the benefits and harms together to reach an aggregate sum. Though this accounting might seem straightforward, there is considerable dispute among theorists about how best to account for welfare (Hooker 2015).

In general, utilitarianism is quite appealing and intuitive, especially under Jamieson's influence (Jamieson's dictum). But there are relevant limitations to this line of justification, both in general (Jamieson 2012; O'Brien and others 2010: 146-7), and in the case of the environment (Jamieson 2007).

The reason for not justifying co-benefits with utilitarian arguments is the difficulty in maximizing these outcomes while maintaining the primary goal of CCM. This shortcoming exists whether future generations' needs are included or not.

In our case, the facilitated purchase of electrical vehicles, designed to increase access to urban outdoor recreation areas, might actually jeopardize recreational quality and attractiveness. In addition, it is challenging to account for urban mobility needs of future generations since they will depend heavily on environmental (e.g. resource availability for battery production) and technological factors that are not under the cities' sphere of influence.

In general, and in the case of public transportation in Hasselt, the justification of co-benefits from a utilitarian perspective might serve the majority (general population) well, but it does not satisfy the interests of minority groups, since the utilitarian principle of increased good for more people subordinates the good for a lesser number of individuals. In the next section, we propose further arguments to show the limitations of this accounting approach. In addition, we will present and discuss other characteristics and impacts of co-benefits that need to be accounted for, if we hope to find a coherent way to understand the moral implications of their rationale.

Some unexpected moral effects of co-benefits

Specialised literature seems to be rather unanimous in regarding co-benefits of CCM as a powerful argument to engage society in a common effort to mitigate climate change (Bollen, Brink, Eerens, & Manders 2009; Ganten and others 2010; Jack & Kinney 2010; Smith 2013). We argue here that, at least to a certain extent, some CCM strategies can, because of their emergent (co-)benefits, be morally justifiable under the reasoning of different moral traditions. This positive effect can also help us understand why a co-benefits rationale is perceived by society as being intrinsically good.

Nevertheless, this scenario hides certain perils when it comes to the accounting of its *raison-d'être*. As mentioned in the Hasselt initiative, co-benefits can, and sometimes do, overshadow the primary reason for putting them into practice, which is to lower GHG emissions (Ganten and others 2010; Puppim de Oliveira 2013).

This reverse reasoning might not seem important at first, but when it is possible to meet the same objective by implementing different actions, the deliberation can become a hostage to considerations (e.g. social and/or political acceptance) that are neither moral nor environmental. For example, in order to decrease GHG in a regional context (Europe), it is possible to opt for reforestation (Olander, Galik, & Kissinger 2012) or for low-carbon energy sources (Ringel 2006), but contextual factors (e.g. international policies and organizations) dictate specific actions, such as European green certificates for renewable energies.

In general, the deliberative factors are different in nature from the main purpose of decreasing GHG emissions, and they can sometimes even be opposed (e.g. public transportation versus private electric vehicles). The decision-making process regarding environmental policies, including CCM, involves various dimensions, but economic and geo-political factors are decisive, both at international and national levels (Haldén 2007; McKibbin & Wilcoxon 2002). Environmental policies are adapted and moulded to accommodate other interests that, in many cases, carry more weight than GHG reductions in the process of implementing CCM measures.

From a purely environmental perspective, certain CCM initiatives, such as the ones related to energy efficiency, can induce the so-called rebound effect (Herring, Sorrell, & Elliott 2009). In the case of our examples, the increased use of EVs, without a concurrent consequential replacement of combustion engine cars, increases energy expenditure. Such an increase always has a negative effect on sustainability, in general through more resources used, and in particular through GHG emissions, if the new electricity demand is satisfied with higher carbon sources than hydropower (Hawkins, Singh, Majeau-Bettez, & Stromman 2013). If

this scenario occurs, the right to a sustainable community (the city of Oslo's commitment) is jeopardized by an apparently greener energy option (electricity).

In the examples cited, although the policies' main focus is mitigating climate change, the intended co-benefits are of different natures (improved mobility in Hasselt and clean water and air in Oslo). As previously shown, co-benefits can be morally justifiable to a certain extent. But the actual turn of events in those cities challenges this scenario.

Free public transportation indeed changed the behaviour of Hasselt's citizens but in unexpected ways, since 'travellers transferred from cars, but cyclists also started using the free bus' (Canters, 2014: 2). This meant that for the former cyclists and for the community in general, neither the primary objective of lowering GHG nor the co-benefit of sustainable mobility were attained. Moreover, there is a large margin of uncertainty regarding the overall impact of this strategy for GHG emissions, since no studies were conducted to ascertain the number of new private vehicles on the road after free public transportation was implemented. Consequently, this raises the question of what the true co-benefit level was.

In general, co-benefits suffer from various difficulties in their accounting and quantification. Their existence and consequent positive effect are dependent on factors (e.g. time frame, scale) that are outside the control of the scientist and/or legislator (Aunan and others 2003). This creates situational conditions that are hard to foresee and to describe. Indeterminacy may threaten the argumentation for scientific, political and moral justification. In the case of the Norwegian EV use incentives in Oslo, the co-benefits of clean air and water are limited to the possible positive effects of the first 50,000 electric cars, since the incentives will stop after that target is reached.

Co-benefits may also create conditions for inequality, real or perceived. Given the fact that EVs are pricier than comparable combustion engine cars, it can be argued that this incentive benefits a group of people that are already better off. Such fact creates more social disparity, which is contrary to the core values of sustainability (Wilkinson, Pickett, & De Vogli 2010).

From the analysis of unintended effects and factors related to co-benefits rationale, the questions that we pose now have new nuances: Are co-benefits (morally) justifiable in themselves, and also as rationale for action on climate change, even if they are difficult to access, may contribute to more inequality, and with some probability, may increase GHG too?

Well-being and freedom: key concepts of co-benefits' moral justification

In a co-benefits rationale, it is very common to depict a consequentialist mind frame that uses models and cost-benefit analyses to focus mainly on demonstrating the good (or in many cases, just the potential good) of implementing certain climate change mitigation actions (Vasconcellos Oliveira and others 2016). The same reasoning can be detected on the urban transportation initiatives in the previously mentioned examples.

Looking closely at Hasselt's free public transportation initiative, it is worth noting that this particular measure was designed to facilitate access for more people for a specific good: mobility. The same principle holds for the subsidized sales of electric vehicles in Norway. It can be argued that the co-benefits of clean air and

water are also goods that will become available to more citizens because of a climate mitigation strategy. The reason that mobility, clean water and air can be labelled as 'goods' is because they have some kind of utility, in the sense of giving clear advantages to the people that have access to them, in contrast to people who do not.

Finding a moral tradition that offers good arguments for the ethico-economic use of co-benefits, besides the deontological one, may yield good outcomes for the justification of some co-benefits. For example, in the case of 'sustainable mobility', we can argue that co-benefits increase the level of well-being, both individually and collectively. Moreover, when the co-benefit involves resources, such as air and water, the utility becomes more visible. This line of reasoning aligns with a simplistic version of utilitarian arguments for what can be considered morally correct, and it is commonly used as a justification argument in co-benefits literature, both political (Bollen, Brink, Eerens, & Manders 2009; IPCC 2013) and scientific (Shrestha & Pradhan 2010; Teng & Jotzo 2014).

Nevertheless, as Vasconcellos Oliveira and others (2016) point out, there are relevant limitations to a consequentialist approach to co-benefits, especially due to the nature of several climate change strategies and to the unexpected effects of some co-benefits.

Despite the difficulties mentioned so far in morally justifying co-benefits and their rationale, the sense of improved citizenship and personal good generated by the action of co-benefits (e.g. access to attractive outdoor recreation areas) is undeniable. It is plausible to link these effects to some kind of improved well-being, which can be related to a moral perspective: the Capability Approach.

In the case of the capability approach (CA) framework, co-benefits are not considered sources of personal utility. They would not be assessed as or compared to a means of freedom, nor as a means to achieve a just equality. In contrast to deontological and consequentialist traditions, CA offers relevant arguments for a more integrative moral justification of a co-benefits rationale because (1) it gives priority to (human) well-being and freedom, accommodating both (2) the uncertainty of co-benefit outcomes and (3) possibly some problematic trade-offs.

Primacy of human well-being

The well-being in the CA perspective is quite distinct from the widely known utilitarian notion. In the capability approach, '[the] achievement of a person can be seen as an evaluation of the "wellness" of the person's state of being' (Sen 1993: 276).

Applying Sen's perspective, it is possible to establish that if the co-benefits enable the subject's functionings¹³, they can be morally justified, since 'functionings are seen as central to the *nature* of well-being' (Sen 1993: 276). In addition, co-benefits can also be defended if they assist in expanding 'feasible alternative combinations of these functionings' (Anand, Hunter, & Smith 2005: 12). In other words, if co-benefits extend peoples' capabilities¹⁴, then they can be justified.

Nonetheless, CA's central focus on the individual may create concerns about the possibility of a moral justification for co-benefits that occur separately, in time and space, from the agents that make the investment. This particular aspect is a very acute problem in CCM and climate change adaptation discussions, especially related to issues of justice and equity between nations (Shukla 1999) and individuals (Jamieson 2001). The current debate about the implementation of certain measures, such as carbon taxes or north-south technology diffusion, seems to be dominated by

questions regarding who pays for and/or receives the benefits from investing in CCM strategies (Rübbelke 2011; Speck 1999).

An alternative to the erosion of the co-benefits rationale due to the issues mentioned above is to shift the moral focus from an impersonal collective to the individual, here considered to have external sources of well-being (Sen, 1985). This particular idea of integrating others' considerations, without 'externalizing' them, justifies the adoption of CCM strategies that produce co-benefits which improve others' functionings and capabilities.

The fact that CA puts the individual at the centre of moral (and social) evaluation is aligned with a general sustainability perspective (Seghezzeo 2009). CA still leaves room for further developments 'without rendering it anthropocentric' (Mabsout 2015: 88) and making it possible to include co-benefits that involve non-humans (e.g. biodiversity) (Onaindia, de Manuel, Madariaga, & Rodríguez-Loinaz 2013) in the same justification rationale.

Ballet, Bazin, Dubois, and Mahieu (2011: 1832) write that 'natural resources and the environment more generally, play a key role in shaping the structures of people's capabilities through the opportunities and constraints that they generate. In other words, they reinforce or inhibit people's ability to build real freedom for themselves, and to choose amongst various types of freedom'.

Another advantage offered by the CA evaluation system is that it combines, and extends, the consequences for the individuals (advantageous and disadvantageous), and the non-sequential features of the human dimension, such as deontological rights (Osmani 2008).

Using CA, it is possible to justify both the co-benefits arising from the initiatives previously described in this paper, and also the CCM actions that led to the co-benefits. The reason for this is that they both strive to extend the agents' capabilities and functionings. In the Belgian initiative, the guarantee of the right to mobility for all residents is in accordance with a society which promotes the 'intrinsic dignity of human freedom and people's ability to be subjects of their own' (Deneulin & McGregor 2010: 514) are relevant goals.

The same line of argumentative justification also responds adequately to the different types of co-benefits that exist. The co-benefits used here as illustrations exemplify both basic (right to clean air, clean water) and complex functionings (right to sustainable mobility and access to attractive outdoor recreation areas), which determine the justification for their pursuit, and also for the strategies that make them a reality.

The unfinished and therefore open nature of the well-being concept in this framework enables the addition of new and more multifaceted factors that improve agency. In the words of Sen (1993: 274), 'the functionings relevant for well-being vary from such elementary ones as escaping morbidity and mortality, being adequately nourished, having mobility, etc., to complex ones such as being happy, achieving self-respect'.

One of the challenges to the co-benefits rationale previously mentioned was how to justify (morally, socially and even environmentally) the goodness of co-benefits and their rationale, if there is uncertainty about the real positive outcomes of certain CCM strategies. As described before, positive effects can mask unfairness (e.g. privileged access to better e-cars by a small number of well-off Norwegians) if considered from a deontological or even utilitarian perspective.

But improvement for a few (i.e. happiness for small number of well-off Norwegians) might still be morally justifiable through the CA lens—which is vague and purposely incomplete (Basu 1987) in its description of well-being. It is possible to claim that sustainable mobility and driving EVs improve the agency of those particular individuals by creating more and better possibilities for them to live their lives.

The evolving nature of CA's well-being concept accepts more and newer capabilities and ways to achieve them. This is particularly relevant for the co-benefits rationale because not all positive outcomes are theoretically predictable, and also because newer climate change mitigation strategies are being devised and enacted every year (Biesbroek and others 2010; Birkmann, Garschagen, Kraas, & Quang 2010; Moss and others 2010).

To maintain coherency, the co-benefits rationale must adapt to newer benefits and their characteristics but still not fail to analyse them. By integrating a CA perspective, which includes continuous evaluation of well-being and agency success, the co-benefits rationale would be in sync with the continuous and innovative nature of CCM strategies, without losing moral credibility.

The looser and non-static description of well-being in CA can also effectively account for the socio-economic and historic-cultural contingencies which a co-benefits rationale faces in particular sub-settings of the original political or geographic incidence. For example, Wittman & Caron's (2009) study shows that the implementation of a global CCM plan (Clean Development Mechanism of Kyoto Protocol) had very different impacts, depending on the national context. Implementing a global common strategy also had unintended effects, such as an increase in social inequality in some countries. Using CA to assess the plan would be an example of what Alkire (2005) calls a 'situated evaluation'. This means that consequences and obligations (e.g. rights) would be considered to reach a decision (direct, indirect, foreseeable and unintended), within a framework of integrating human development with well-being.

The importance of freedom in co-benefits trade-offs

Both politicians and scientists face great challenges in how to deal with trade-offs when devising and establishing measures to combat anthropogenic CO₂. The biggest part of the burden is knowing how to prioritize negative outcomes (e.g. valuation of environmental impact categories)¹⁵. Nevertheless, with the introduction of a co-benefits rationale in the overall climate change discourse, the burden of trade-offs now includes another dimension. By taking account of the positive effects of CCM strategies in the political agenda, reflecting on the establishment of action guidelines and priorities for 'distributing' benefits is inevitable.

In this paper, trade-offs will not be extensively dealt with since they are not a prime objective. Nonetheless, we will add some newer arguments, just within the co-benefits rationale, which might secondarily impact the ongoing discussion on matters of CCM trade-offs.

In our opinion, with the diversity of co-benefits and the settings where they arise, creating a system where guidelines for their moral evaluation are flexible and not established a priori is critical to accommodate this diversity. Because of the evolving nature of the climate change phenomenon and of the human relationship to it, any

principles used to judge the importance and allocation of benefits must be in relation to the society that created them, and also in relation to humanity.

Sen offers a powerful tool for a more integrated path to decisions on these matters in his CA framework. He advocates for a system of social evaluation that makes space for the evolving nature of human society and for the relationship between it and climate change. The system promotes diversity and citizenship, values that are in consonance with the ones promoted by sustainability.

‘Three meta-principles lie at the foundation of Sen’s system of social evaluation: (1) emphasis on the need for incorporating informational diversity in structure of analysis, (2) advocacy of the notion that no moral system may be capable of yielding a complete evaluation in a world characterized by irreducible plurality of values and attributes of both individuals and of social state they inhabit, and (3) a deep commitment to democratic values’ (Osmani 2008: 31).

Using the above principles may help decision-makers deal with co-benefits trade-offs by (1) sharing the burden of decision making with the rest of the citizens, (2) achieving, or at least making an effort toward, social consensus, increasing the opportunities for (3) reflecting on climate change mitigation, and (4) reinforcing the importance of civil society through (5) democratic procedures.

The democratic traits of this process relate directly to a central concept for decision-making: freedom. It may be impossible to reach a complete and satisfying answer to all trade-offs, but an open social construct around values and expectations increases the possibility of achieving something meaningful for more people.

There is also an individual level of freedom in this process, which translates to the possibility and responsibility of being an active part of the reflection and decision-making process around co-benefits. According to Anand and others (2005: 43), the objective of policymakers should not be to make choices for people or tell them what to do, but should rather focus on ‘enhancing the choice set available to everyone’.

In conclusion, several plausible arguments exist for a shared belief that co-benefits are good and that their rationale has enough moral force to impact the general CCM discourse. Such arguments resonate particularly well with the CA approach, especially if the justifying arguments revolve around well-being and freedom as discussed. Despite some possible negative effects of particular CCM strategies, co-benefits argumentation can be a good ally in the struggle for change if the rationale is built around the improved agency of the individual. A collective discussion on what CCM actions are justifiable under the umbrella of a co-benefits rationale, while protecting individual opportunity to achieve what one considers valuable, would support this struggle for change.

The shape of a co-benefits rationale under CA

As argued in the previous sections, a co-benefits rationale is influenced mainly by the utilitarian and deontological traditions. However, if a CA moral framework is applied to a co-benefits rationale, CA alters both the rhetorical-persuasive and ethico-economic uses of this concept.

In order to show such modification, we will use the examples of the urban transportation initiatives of Hasselt and Oslo to (1) confirm the impact of the moral

framework in the policy outcome, (2) better distinguish between the moral influences in the co-benefits-CCM policy and (3) draw a possible scenario where a co-benefits rationale is under CA influence.

As previously mentioned, both Hasselt's and Oslo's urban transportation initiatives were influenced by ethical-moral guidelines that reflect the deontological tradition. Yet, had the initiative design and supporting documents applied this ethical tradition in a coherent way, other arguments would have been included.

Supporting statements would most likely have argued that national and local politicians could facilitate and/or make possible the right kind of mobility to address sustainability issues in all cases (e.g. public investment in free public transportation is the best way to guarantee sustainable mobility in all cities).

Policies might state reasons why they choose to treat their citizens in certain ways and/or why they permit the rights' holders to act in a particular fashion, even if some social and environmental aims would be served by doing otherwise (e.g. cycling emits less GHG and allows mobility freedom).

In other words, under the influence of a rights tradition, politicians would establish and endorse these initiatives (public transportation and EVs) because citizens could demand not only the possibility of having greener transportation options, but could also claim that the state had a responsibility to incentivize them. Policymakers would thus feel a duty to create such initiatives as responses to their 'moral obligation' towards national and/or international compromises in decreasing CO₂ emissions¹⁶.

If the same politicians were to adopt a utilitarian framework, the initiatives and supporting documents would have distinct characteristics.

In the case of Hasselt's mobility programme, the free public transportation programme might maintain the same practical characteristics because more citizens would have access to improved mobility. In addition, by making it free, all economic strata would have access to the benefit.

The Norwegian strategy favouring the purchase of EVs would probably not be implemented in a utilitarian framework, since alternative ways to decrease urban GHG and foster a sustainable urban community could give everyone—not just those able to afford an EV—access to clean air, water and attractive outdoor recreation areas. The Hasselt example would be a striking alternative for this framework.

However, if both initiatives were implemented, the related policy documents would then portray much different arguments than the original ones. The quantification of benefits would likely serve both as rhetoric-persuasive and also as ethico-economic arguments to sustain the claim of increased citizen satisfaction and happiness and/or to show economic gains in those particular regions, i.e. through the use of indicators such as gross value added (GVA). For instance, reports and other official papers could mention the growing number of satisfied passengers using Hasselt's public transportation, the increase in local car trade or even the rising number of environmentally conscious Norwegians who now had the chance to buy an EV.

This kind of improvement in the overall good would be enough to justify the political and financial investments driven by the implementation of the strategies.

Supposing that CA would influence the co-benefits rationale of our examples, the shape of the initiatives would again be rather different from the frameworks

mentioned above. Freedom and well-being would be the key guidelines for establishing any CCM programme, and a period of citizen consultation would be highly probable. This pre-event would enable people to venture their opinions or to choose from options given by the local or national authorities. This framework would create a much more bottom-up process, in which democratic procedures and citizen input would dictate the positive outcome choice.

Regarding possible argumentation to sustain the initiatives, the overall reasons in the policy documents might remain unaltered, since CA accommodates both rights (moral and legal) and an increase in good outcomes. Nevertheless, additional arguments would be added to support such claims, since CA promotes the inclusion of multiple principles (e.g. distributional concerns for the least well-off, or universalization principle) in the evaluation process. CA's plurality of informational sources and moral principles contrasts with the other traditions, especially deontology.

A co-benefits rationale with a CA slant—as distinct from abstract utilitarian maximizing principles or deontological universal principles—would include a contextualized (space and time) search for ways to achieve social justice. If the Hasselt and Oslo urban transportation initiatives had been shaped by CA, the supporting political documents would mention how the moral and political choices were made.

Of greatest relevance with respect to the influence of ethical traditions in a co-benefits rationale is that a CA approach would transform the implementation of CCM strategies into a moral 'multi-criteria' process. This process would give citizens an active voice in selecting which added benefits they consider worth having. Communities would likely repeat the selection process to continuously stay in accordance with what citizens believe to be adequate for their own situation. Again, CA reveals a significant difference from other ethical perspectives. For instance, since deontological or utilitarian moral principles are established a priori and in a single phase, it would not be necessary to morally 'revise' the value of the initiatives or their sustaining argumentation.

CA would transform a co-benefits rationale in such a way that citizens would become directly responsible for their choices, and consequently, the political rhetoric-persuasive side would carry less weight in the rationale. Instead, the focus of the rationale would be on how to better translate improved agency into action, i.e. how could co-benefits enhance those people's valuable doings and beings. In addition, and again in contrast to other moral perspectives, more stakeholders (e.g. NGOs, minority political parties, civic organizations, SMEs) would be invited to participate as a result of integrating a plurality of values and information during the deliberating process.

A democratic process of analysis and choice with regard to CCM strategies and possible favourable outcomes might also yield another positive outcome: increased population engagement. This engagement might, in the case of our examples, prevent media criticism (Oslo) and termination of the initiatives (Hasselt). The possibility to re-shape the initiatives according to citizens' moral understandings and social expectations might also create a more favourable environment for CCM.

Conclusions

Presently, co-benefits are included in CCM strategy as positive outcomes of the social and economic effort to combat anthropogenic CO₂ emissions. Besides these emergent effects from implementing particular initiatives, a complete rationale conveys the message of rightness and also serves as justification for carrying out several of these actions. A shared notion of correctness and the use of co-benefits as moral arguments in favour of particular socio-economic and political actions deserve to bear ethical scrutiny, in order to understand if there can be a moral justification for co-benefits and their rationale.

By closely analysing two European urban transportation programmes designed to decrease GHG emissions, it was possible to unveil how the prevailing co-benefits rationale deterred the supposed original aim (CCM). Moreover, the analysis also showed how co-benefits themselves and their reasoning may not serve the prime objective of avoiding GHG and may even create more inequality.

As argued here, a co-benefits rationale is used to sustain and promote positive attitudes towards the CCM effort, but this practice can compromise the prime objective without adequate moral framing. Co-benefits literature and policy documents, as revealed here by our two examples, contain several reasons and arguments based on both deontological and utilitarian ethical traditions. However, neither of these ethical theories is able to properly justify them, due to the very dissimilar nature of the co-benefits and their practical settings.

The notions of well-being and freedom, as conceived by CA, offer a coherent line for the moral evaluation of these emergent outcomes, and also of the actions that originate them. By centring the moral argumentation and validation on enabling and favouring individual capacities and functionings, there is a chance of establishing a more coherent rationale.

The other pillar for an articulate moral justification of co-benefits is individual freedom. This freedom is defined as the factual possibility of choosing, individually and collectively, which benefits are morally valid and the reasons for that choice. Individual moral reflection, together with a system of social moral evaluation, creates a shared understanding of what is morally positive about both co-benefits and CCM strategies.

In a scenario where CA would shape a co-benefits rationale, the application of CCM strategies would rely mainly on bottom-up planning, which would increase citizen engagement in setting and meeting the targets for CCM.

Co-benefits and their rationale can become better allies of CCM action if they are grounded in a moral frame that integrates change and diversity. The effects of CCM actions are so multifaceted and complex that they pose severe implementation obstacles. We argue here that giving moral strength to emergent CCM outcomes that enable freedom and well-being can reduce these barriers.

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Notes

¹ NICHES⁺ is an example of an international project designed to decrease urban GHG. For further information visit the webpage http://www.transport-research.info/web/projects/project_details.cfm?id=11075

² The Ecodrive Programme is an initiative for Dutch cities. For further information visit the webpage <http://www.hetnieuwerijden.nl/>

³ The city of Stockholm developed the Environmental Zone initiative for tackling urban GHG. For further information visit the webpage <http://foretag.stockholm.se/Tillstand/Trafik/Miljozon1/>

⁴ 'We are talking about taking measures that will add years to our life and add life to our years'. Wilfried Karmaus in Lambrechts (2001).

⁵ 'The Hasselt MOBILITY PLAN [...] has 11 main objectives [...]: 1. Increase traffic safety; 2. Directional parking policy; 3. Increase the use of bikes and public transport as traffic-safe alternatives to cars; 4. Guarantee a right to mobility for everyone; 5. Reduce the amount of space for private traffic and replace this with quality living space; 6. Make the city more concentrated around public transport connections; 7. Improve accessibility for all forms of transport to the city from borough centres; 8. Improve day-to-day facilities in the boroughs; 9. Improve facilities for pedestrians in the boroughs; 10. Manage the CO emissions by investing in methods to slow down the increasing number of kilometres travelled; 11. Integrate the mobility goals into town planning (Lambrechts 2001: 6).

⁶ Besides the establishment of a wide charging net, other incentives were also put in place for EV owners such as free charging in public charging stations, use of bus lanes, and toll exemptions for Oslo's ring road. Moreover, until the number of EV cars reaches 50.000, these vehicles are exempted from purchase tax and VAT (Pas 2014).

⁷ The works of Jack and Kinney (2010), Nemet and others (2010); (Zhang & Wang 2011) are good examples of the positive weight that co-benefits and their rationale carry in literature.

⁸ Mobility is here framed in the sense of possibility to leave and return to one's native country, which is established in the Universal Declaration of Human Rights in article 13-2.

⁹ Deontology is considered here to integrate all moral theories that establish and reflect upon what is right to do in the tradition of Kantian ethics.

¹⁰ The establishment of a right to an extended mobility [for example to migration] requires argumentation outside the Human rights moral and ethical framework (Pécoud & De Guchteneire 2006).

¹¹ 'One striking outcome of the introduction of free public transport in Hasselt was that the number of visits to patients in the hospitals was reported to increase enormously. Free public transport might in this way be a means to prevent elderly people of becoming lonely' (Van Goeverden and others 2006: 7)

¹² For more on the concept of interest, read Scanlon (2008).

¹³ '*Functionings* represent parts of the state of a person – in particular the various things that he or she manages to do or be in leading a life. [...] [This] approach is based on a view of living as a combination of various 'doings and beings', with quality of life to be assessed in terms of the capability to achieve valuable functionings' (Sen 1993: 271).

¹⁴ ‘The *capability* of a person reflects the alternative combinations of functionings the person can achieve, and from which he or she can choose one collection’ (Sen 1993).

¹⁵ This topic is extensively discussed by Ahlroth (2014).

¹⁶ Both Norway and Belgium have signed several international protocols regarding climate change, such as the Kyoto protocol (EEA 2014).

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Paper III

Article

Back to the Future: The Potential of Intergenerational Justice for the Achievement of the Sustainable Development Goals

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Abstract: The establishment of the UN Sustainable Development Goals (SDGs) bolstered momentum to achieve a sustainable future. Undeniably, the welfare of future generations is a fundamental value of sustainable development since the publication of the Brundtland report. Nevertheless, SDGs and their targets are meagre on intergenerational justice concerns. The 15-year target horizon of the SDGs might be beneficial for implementation reasons. However, such a short-term perspective is far from innocuous in justice terms. It jeopardises the establishment of long-term goals, which protect both present and future people. This article advocates for clearer stances on intergenerational justice. What type of distributive principles could and should dictate the present socio-economic development? Looking at *intragenerational* justice principles contained in SDGs does not provide a full answer since they express conflicting visions of what constitutes a fair development. Furthermore, a fair distribution of the development benefits and burdens among present and near future people does not necessarily guarantee the wellbeing of more distant generations. I propose an *intergenerational* sufficientarian perspective as a way of extending the beneficial impacts of SDGs to both close and distant future generations. Hopefully, it facilitates the translation of the SDGs into policies that promote fairer implementation strategies.

Keywords: sustainable development goals; intergenerational justice; sufficientarianism; sustainable development; future generations; justice pluralism

1. Introduction

The path towards a common vision for sustainable development took a major step with the publication of the UN Sustainable Development Goals (SDGs) in 2015. In comparison to the Millennium Goals, the 17 SDGs go further in creating additional aims directly related to distributive justice.

There is a consensus that, to achieve the SDGs, policy-makers, scientists, and practitioners have to clarify how the corresponding 169 targets interconnect, analyse trade-offs and synergies, and develop metrics and models [1,2]. The need for analysis and clarification on the ethical implications of the SDGs is far less recognised. The consideration of general justice principles that are, and should be, embedded in the SDGs is yet to be fully developed. This analysis is much needed, since these principles guide the political translation of the goals and targets in concrete strategies and policies that affect us all [3,4].

So far, the reflection on the value of justice of the SDGs is mainly related to a casuistic analysis of specific goals. For example, SDGs 2: ‘zero hunger’ [5] and 3: ‘good health and wellbeing’ [2,6] have been the subject of research articles concerning justice. The limited research in this area shows the necessity of examining the general principles embodied in the SDGs and associated targets.

The focal point in this article is restricted to the intergenerational component within the wider landscape of distributive justice. The main reason for this choice resides in the nature of sustainable development. Despite different interpretations on what sustainable development is, and should

be [7,8], it is generally agreed that a desirable development for humankind is one that maintains and fosters conditions for present and future wellbeing. This stance clearly establishes the interests of future generations as a pillar of sustainable development. The centrality of future generations' interests is fully recognised in the published material by the UN [9]. Consequently, it would be expected that the SDGs substantiate the importance of future generations. However, for a variety of reasons, the majority of the SDGs are narrow in temporal scope, leading to a limited focus on future generations. Concerning future people, I claim that the SDGs focus on immediate generations, and do not ensure a fair future for more distant descendants. Moreover, there can be conflicting interests between near and distant future generations derived from short-term sustainable development policies. If the SDGs would have a longer temporal scope, generational disputes can be eased and, in some cases, even prevented. Furthermore, the adoption of an extended temporal perspective reinforces the commitment of nations to sustainable development beyond political cycles.

This article aims firstly at discussing how the lack of concrete intergenerational principles in SDGs affects their (short- and long-term) success. Secondly, there is a proposal of the reinforcement of a justice framework based on the attainment of minimal conditions, when contextualising and implementing the SDGs. Such a framework has the potential to realistically extend the benefits of goals to more distant generations than the ones covered by the SDGs.

The article is structured in the following way: it starts by analysing which generations are targeted by the SDGs. Afterwards, there is an analysis of what kind of justice principles are embodied the SDGs texts, concerning both near and distant future generations. Further on, there is a section dedicated to distributive justice and environmental reasons for the reinforcement of the intergenerational sufficientarian justice framework in the SDGs. Finally, concrete intergenerational sufficientarian sub-targets are proposed with the aim of protecting the wellbeing of near and distant future generations.

2. The (Im)Balance in the Wellbeing of Present and Future People

Unquestionably, SDGs try to respond to some of the most pressing problems that contemporary societies face. By redirecting development, SDGs hope to achieve better standards for people, institutions, and the environment. Like in the case of the Millennium Goals [10], SDGs are morally framed by the value of justice. More precisely, SDGs integrate statements mostly about distributive justice (theories of distributive justice support specific frameworks for dividing benefits and burdens among citizens; the justifications for such distribution are based on moral arguments that serve to guide political processes and structures [11]). SDGs set targets on how to 'better' share development costs and benefits among populations and individuals. The orientation towards distributive justice is particularly recognisable in goals such as Goal 1: 'no poverty', Goal 5: 'gender equality', or Goal 16: 'peace, justice, and strong institutions'. I further claim that justice concerns are also present in the rest of the goals via indirect pleas on distributive justice, e.g., Target 14.b aims at 'provid(ing) access for small-scale artisanal fishers to marine resources and markets', and Target 15.b requires countries to 'finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation' [12] (pp. 19–20).

It can be argued that from a justice perspective, the prime objective of the SDGs is to provide political targets that will change the course of present development so as to reach specific levels unanimously recognised as fair. Inevitably, follows the question: Who are the justice beneficiaries of these targets?

At first glance, public opinion seems to suggest that the SDGs focus on contemporary society and its individuals [13]. Looking strictly at their content reinforces this idea. There is a strong and declared commitment to the improvement of the wellbeing of the present generation, especially with regard to the worst-off, e.g., in Goal 1, Target 1.b it is written 'create sound policy frameworks (. . .) based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions' [12] (p. 3).

I analysed the temporal scope of each of the 169 targets [12] and summarised the results in Figure 1. In general, the temporal frame of the SDGs extends beyond the present generation and covers its direct descendants. Approximately 48% of the SDG targets have a maximum time horizon of less than a decade and a half (2020–2030) (see Table A1). Furthermore, a considerable number of targets have no temporal scope.

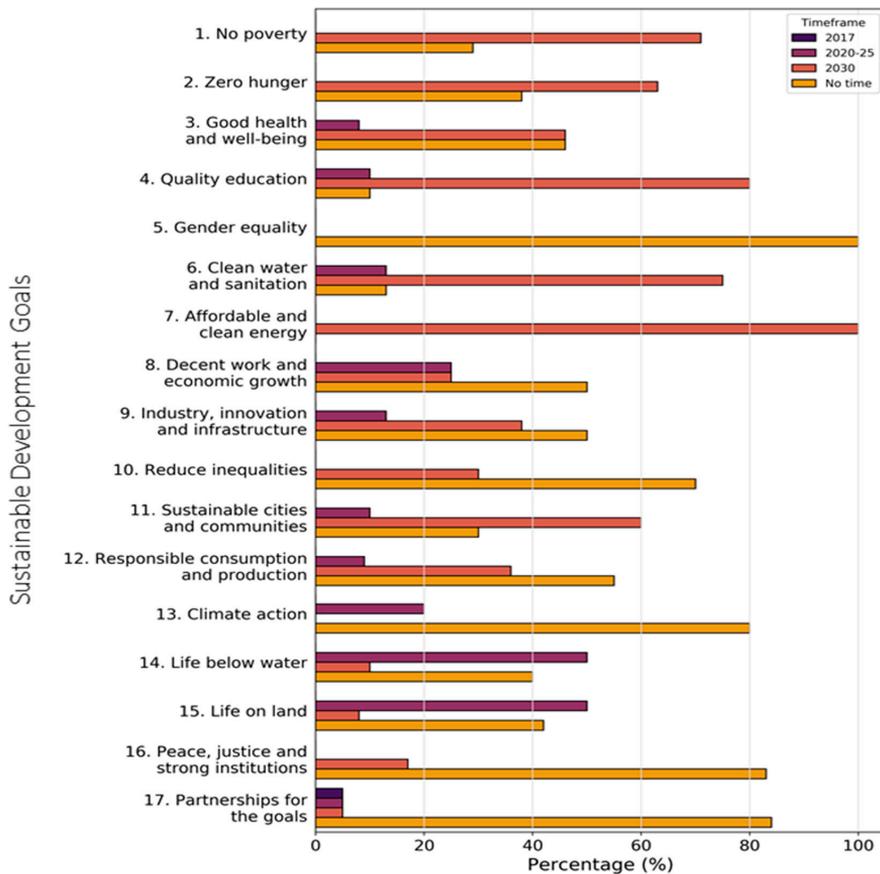


Figure 1. Temporal scale of the SDG targets by goal. The values represent the relative frequency of each specific time period, in the totality of the targets of each goal.

Interestingly, there is a less restrictive temporal agenda in the SDGs' support documentation. Expressions such as 'our common future', 'future generations', 'future challenges' [14], and 'people in the future' [15] set an open timeline for reaching the desired sustainable development level. The frequent use of these generic concepts in the SDGs' complementary and supportive documents remits the justice object to an apparent united and homogeneous group, both in time and needs. The same open timeline was already integrated into previous UN documents, such as 'Intergenerational solidarity and the needs of future generations'. In the same tone as the SDGs' support information, this report calls attention to longer time spans (hundreds of generations) as a way of acknowledging future generations beyond the 'human scale' (three generations) [16] (p. 11).

I believe that such an amalgamation blurs the goals' action landscape, and jeopardises the interests of the temporal subgroups within future generations, as I will explain further on.

It is critical to introduce here a differentiation in generation timing to counteract this indistinctiveness. There are considerable differences in needs (the distinction between proximal and distant future generations may not be necessary when considering solely basic needs since they are largely constant through time and space) and contexts (the level of uncertainty about the physical and the socio-economic future conditions of our planet increases steeply when dealing with scenarios that are more distant in time [17]) among generations. For example, in the late XIX century, society did not need instant communication, neither was it foreseeable to need it, especially in an affordable way. Gradually, information technology became omnipresent, and now individuals expect, and many have the necessity, to communicate over large distances, from everywhere on the planet. The distant future context will surely be different from our current forecasts, due to unforeseeable natural, social, and technological changes, while the capacity to meet those needs can be severely altered due to, for example, resource availability. To capture this dichotomy, I believe it important to distinguish between the cohorts that are immediate and time wise closer to ours—here designated as proximal future generations—and the future people that are further away from our current generation—distant future generations [18].

Authors like Birnbacher [19] and Sterba [20] use similar distinctions when considering the ethical reasons for caring for the distant future (in space and time). However, the authors do not give generational or time references to what can be considered a ‘distant future’ or ‘distant people’. Contrary to the mentioned authors, I consider that a time estimate distinguishing proximal and distant generations is beneficial when addressing sustainable development. For the sake of a systematic analysis of the generational justice principles and the implications of the SDGs, I deem it indispensable to extend and integrate the following time differentiation when analysing the UN’s future development trends. In this article, I define proximal future generations as the cohort of individuals belonging up to a second generation (roughly between 40–55 years) [21], while the people born after this second generation compose distant future generations.

Using the above distinction, I claim that the SDGs’ desideratum should be to foster fair socio-ecological conditions beyond the present and proximal future generations. General claims on the establishment of a better future without concrete long-term intentions and actions will not ensure fairness for distant future generations. It is critical to understand that fair(er) present and proximal future conditions will not automatically ensure a fair distant future. There are two main reasons for such a claim.

First, the non-homogeneity of needs within future generations is bound to create tensions between different temporal cohorts. This means that setting principles and courses of action meant to favour justice towards proximal future generations might conflict with the establishment of principles and actions towards people from a distant future. The main motive for this is an increasing distinctiveness of eco-socio-economic settings as the timeframe extends.

A justice dilemma is presented to illustrate the diversity increment of future scenarios with timespan, and the potential conflict between the interests of cohorts. The dilemmatic situation relates to the consensual fair targets of Goal 7. This goal aims at providing affordable and clean energy to all people by 2030. The achievement of Goal 7 requires the increase in the production and use of renewable energies, especially in Asia and sub-Saharan Africa. Independently of the specific energy source(s) chosen to meet this goal [22–24], the criteria for any option vary according to the chosen timeframe. To achieve energy fairness for proximal future generations, the type of clean energy production structures must be operational in just a few years, and should not require unaffordable initial investments. The variables to consider while guaranteeing energy fairness for distant future generations are of another kind. A fair option should be the one with least future impacts (e.g., costs), while ensuring functionality in diverse future scenarios.

Indisputably, the production of solar energy is one of the favourite options for generating ‘clean and affordable’ energy, especially in low-density population areas like sub-Saharan Africa. Since ‘by 2030, (we should) increase substantially the share of renewable energy in the global energy mix’ [12]

(p. 10), investments in these technologies are to be considered fair actions. However, studies indicate relevant (health and environment) toxicity burdens in the production of solar PV, which will mainly impact distant future generations. The situation will be further aggravated by technology upscaling. Recent research findings point to significant effects in an extensive production growth scenario [25]. Simply put, actions meant to increase energy fairness ought to account for lock-in effect [26] and potential adverse consequences for distant future generations of some of the technological possibilities. In line with this argument, and using a similar example, Kermisch and Taebi established a framework for evaluating nuclear energy that has the interests of close and distant (remote) generations at its centre. By doing so, the authors argue it affects the very notion of sustainability [27].

Another reason for distinctly addressing the wellbeing of proximal and distant future generations, in the context of SDGs, relates to responsibility and agency. Both present and proximal future generations determine the possibility of a fair development for (proximal and distant) future generations. In that sense, they are both responsible for future conditions. However, only proximal future generations are foreseeable agents of the future. Since present generations cannot fully foresee or determine (at least, all) proximal future generations' actions, the SDGs' moral framework must give latitude to proximal future generations for them to adapt to future scenarios, without compromising the interests of distant future people.

As they are written today, SDGs and their targets leave the door open to social and environmental injustice for (distant) future generations. They do not acknowledge and respond to ascertainable potential contradictions in principles and actions taken to ensure the wellbeing of those future people. All in all, the core ambition of sustainable development is to meet the needs of the present without compromising future generations to meet their own needs [28], and, by extension, SDGs are not accomplishable without the inclusion of (some) longer-term targets.

3. The Distributive Justice Principles in the SDGs

Societies have a determined social background in which the partition of economic, environmental, and cultural benefits among citizens is differentiated. Such differences are a product of socio-economic and ethical frameworks, which change over time and across societies. Like with many other ethical problems, the answer to what is the correct way to share these benefits and burdens varies. The different positions about morally-preferable frameworks and/or resulting distributions lead to differentiated practical societal scenarios. These differences demand consideration and reflection when devising policies for a more sustainable future.

As mentioned before, the SDGs aim at transforming the current eco-socio-economic landscape into a future with a fairer division of benefits and burdens. To make clear the different stances on justice concerning future generations, I analysed the SDGs for distributive justice principles behind the concrete developmental objectives. I orient and benchmark this examination against the theoretical claims of the distributive justice theories.

The examination was narrowed down to the documents that specifically enunciate the goals [29,30], leaving out the supporting literature and documentation, since the signing countries did not officially endorse them. Each of the 17 SDGs is individually contextualised and justified in three sections ('progress and info 2016', 'progress and info 2017', and 'targets and indicators'), which form the documental basis of my investigation. I narrowed the focus to the final list of proposed SDG targets and indicators [12] and performed a textual analysis for all 169 targets in search of (*intra- and intergenerational*) distributive justice principles that affect present and future generations.

The distributive justice principles were categorised into three classes, according to the theoretical criteria of sufficientarianism [31,32], egalitarianism [32,33], and prioritarianism (prioritarianism belongs to the family of egalitarian theories; however, it was individualized from the general egalitarianism, since it focuses primarily on the worst-off instead of the general population) [33,34]. To classify a target as being part of a class, certain keywords, concepts, and phrases distinctive to each class had to be present in the target's text [12]. In the case of target descriptions without clear

distributive justice claims, it was classified as without justice statement (see Table A2). Table 1 shows the corresponding classification of key concepts for each distributive justice theory. Table A3 provides a more detailed overview of the textual analysis.

Table 1. Correspondence between key concepts and distributive justice theories.

Justice Theory	Concepts
Egalitarianism	Universal; equality; inclusiveness; global justice
Prioritarianism	Specific population groups; Specific communities, businesses, or countries
Sufficientarianism	Explicit thresholds; increases or reductions of parameters

The SDGs' targets were classified according to the concepts and keywords correspondent to the three different distributive justice classes. However, in the case of multiple concepts present in a single target, the target is counted as having a double (or triple) classification. Subsequently, the absolute count of classes for all targets with justice statements was normalised, and these relative results are presented in Table A2. Figure 2 plots the SDGs in the egalitarian-prioritarian-sufficientarian triangle. Their position is based on the average position of the associated targets reflecting egalitarian, prioritarian, or sufficientarian justice frameworks. The size of the circles corresponds to the relative amount of targets in which a justice position is incorporated, i.e., the smaller the circle, the more targets have no justice positioning. Figure 2 shows that the distribution of justice claims among SDG targets is not homogeneous. Eighty percent of the analysed targets have some form of justice statement. In these targets, intergenerational egalitarian and prioritarian views are predominant, covering, respectively, 46% and 43%. Intergenerational sufficientarian principles are far less common and represent only 11% of targets, as represented in Figure 2.

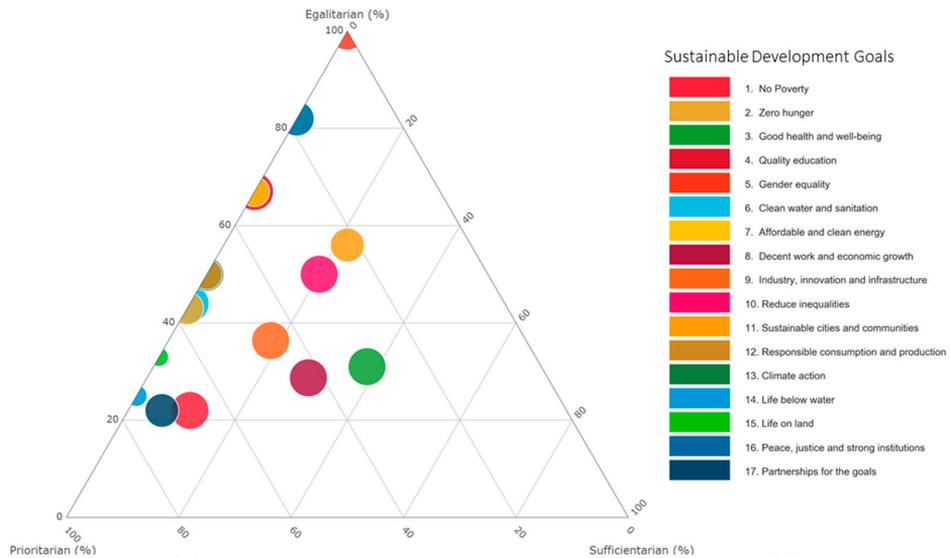


Figure 2. Results from the textual analysis on the SDGs targets which contained (*intra-* and *intergenerational*) distributive justice statements. Each of the targets was benchmarked against the principles of equalitarianism, prioritarianism, and sufficientarianism. The results are grouped by goal (for detailed information, see Table A2).

Figure 2 shows a predominance of egalitarianism (egalitarianism is the distributive justice theory that states that societal burdens and benefits (e.g., wealth, income) should be divided equally among

all citizens. This falls on the postulate that all human beings are equal in worth and in moral status. When egalitarianism is applied to future generations, the result is the obligation of distributing equally the burdens and benefits among present and future people [35] in subjects like peace, justice and institutions (Goal 16), and in quality and education (Goal 4). In these topics, the SDGs aim at distributing more evenly the benefits of development. Equalizing rights and redistributing resources more evenly is so relevant in the SDGs that the UN dedicated a goal to promote gender equality (Goal 5). Furthermore, there are strong appeals to egalitarianism in every other goal, e.g., in Goal 10, countries are urged to reduce ‘inequalities in income’ [12] (p. 13) (for detailed information, see Table A2).

Prioritarianism (prioritarianism favours welfare for the worst-off people. It is very relevant for this justice view, the different levels of the welfare that individuals have in an overall wellbeing scale: the worse off a person is, the greater importance his or her improvement of wellbeing has [36]) is another relevant and constant distributive justice framework in the SDGs. All goals include statements about giving precedence to the worst-off (‘in particular the poor and the vulnerable’) [12] when establishing concrete actions to diminish inequality. The preponderance of prioritarianism happens in developmental topics connected to aquatic resources (Goal 14), partnership for achieving the goals (Goal 17), poverty (Goal 1), and land resources (Goal 15). Not surprisingly, there are individual SDG targets that incorporate both egalitarian and prioritarian justice frameworks (for detailed information, see Table A2).

The sufficientarian principles of justice (sufficientarianism is a theory of distributive justice that is neither concerned with inequalities, nor with making the situation of the least well-off as good as possible. The objective of sufficientarian justice is to ensure that each individual has enough. In an intergenerational context, sufficientarianism requires that present generations leave enough resources for the future people insofar that they will have minimal life conditions [37]) are not prevalent in the SDGs, as shown in Figure 2. The SDGs infused with such justice have a focus on human development, which benefits individuals below certain wellbeing thresholds. The goal on health (Goal 3) exemplifies the moral priority of bettering the wellbeing of those who fall below a minimum of health coverage quality, namely in maternal and new-born health (Targets 3.1 and 3.2). The improvement of working conditions below decency is also another relevant sufficientarian target (Goal 8) (for detailed information, see Table A2).

In general, the results show a common ideal of sustainable development, which nurtures a future with less social and environmental inequality. The analysis also reveals a more diversified vision on distributive justice parameters in some particular issues (see Figure 2). The SDGs’ core texts transmit the notion that, in particular cases, it is not enough to guarantee all citizens equal access to resources and opportunities, but rather ensure basic conditions for all people. There is a kind of ‘justice pluralism’ in the sense of an agreement in adopting contrasting general justice principles concerning the problem of mitigating distribution inequality [38,39]. The mix of justice principles in the SDGs opens space for devising implementation strategies, which ensure that present, proximal, and distant generations achieve a developmental state where these conditions are met.

4. A Fair Future for All Generations: Integrating Sufficientarianism in the SDGs

As discussed previously, sustainable development targets can only be considered true to the cause of sustainability if they integrate measures that ensure distributive justice to both proximal and distant generations. Consequently, SDGs should incorporate general justice principles that safeguard a fair allocation of benefits and burdens among all generations to come.

As discussed in the previous sections, SDGs adopt a ‘pluralistic’ distributive justice frame for present and proximal future generations, but miss out on the wellbeing of distant future people. This situation creates the opportunity of proposing the integration of distant future generations’ interests, in the SDGs implementation strategies. Such integration can be translated in the development of sub-targets (e.g., national, regional) for proximal and distant future generations and/or the introduction of intergenerational sufficientarian sub-targets when assessing the implementation actions. The main

aim here is a more systematic consideration and application of intergenerational sufficientarian principles in the sustainable development strategies.

4.1. The Cause of Future Sufficiency

To make a case for intergenerational sufficientarianism for future generations, it is fundamental to understand the main characteristics and implications of this justice theory. Sufficientarianism, in an intergenerational context, dictates that the measure of fairness is the wellbeing of future people in relation to a certain threshold. Strictly speaking, the distribution of benefits and burdens among generations must be such that all cohorts reach minimum life standards [33]. Present generations have the duty to create the conditions so that no future individual falls below the sufficient level. Contrary to the intuition of many, intergenerational sufficientarians think that an equal distribution of benefits and burdens among cohorts is not, per se, a just allocation. The level of (in)equality among individuals of different generations is of no importance for intergenerational sufficientarians [31–33]. Their concern is that every individual attains a minimum standard of wellbeing (from a theoretical perspective, ‘classical’ sufficientarianism is compatible and combinable with other intergenerational justice perspectives such as egalitarianism. Sufficientarian principles are very similar to some forms of egalitarianism such as the up-limit leximin egalitarianism and the utilitarian aggregative perspective on wellbeing/welfare. Up-limit leximin egalitarianism and prioritarian perspectives are non-individualistic. The prime objective of both is set on total wellbeing [40]), as shown in Figure 3.

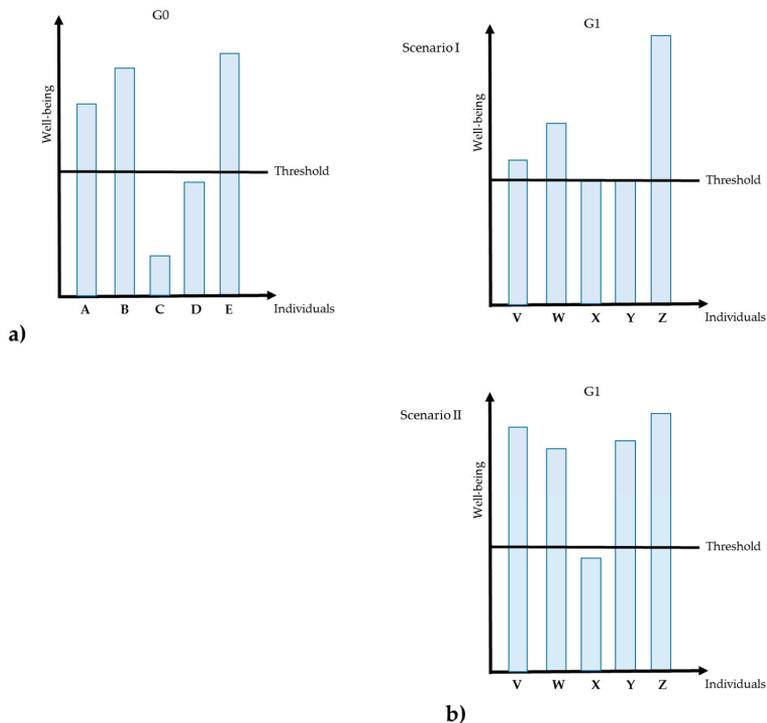


Figure 3. Examples of fictitious wellbeing distributions between two generations. (a) Wellbeing distribution in the initial generation; (b) Two potential wellbeing distributions in the following generation. Scenario I follows sufficientarianism, while scenario II follows egalitarian and prioritarian distributive justice principles.

Figure 3 shows a hypothetical example of wellbeing distribution among generations. In this example, the present generation, or generation zero (G0), is composed of five individuals with different levels of wellbeing. For the sake of simplicity, it is assumed that the generation after G0 (G1) has the same size as the previous one. For the same reason, it is assumed that there are only two possible distributive justice possibilities: scenario I and II. According to intergenerational sufficientarianism, only scenario I is fair. Despite scenario II having more aggregated wellbeing and less inequality, it is not a just future because individual X has not reached the minimum threshold of wellbeing. Intergenerational sufficientarianism requires all G1 individuals to have minimum standards of wellbeing.

In a nutshell, for intergenerational sufficientarians, one must support a present human development that ensures *all people, at any future time, have at least minimal levels of wellbeing*.

4.2. Reinforcing Intergenerational Wellbeing beyond the Near Future

It is not enough to promote equal sharing of eco-socio-economic resources and burdens, within the present and near-future generations to guarantee that future people enjoy desirable living conditions. Wellbeing equality among generations might compromise the necessary ecological balance, especially with growing demographics [41].

In light of this, I propose the strengthening of intergenerational sufficientarian distributive justice standards in the context of the SDGs. The reinforcement of sufficientarian justice principles in policies targeting future development is also necessary for the following reason: in comparison to other distributive justice theories, especially egalitarianism, sufficientarianism is particularly useful and favourable in a general intergenerational context [31,34,42]. In response, some authors try to offer potential distributive justice approaches that overcome the intrinsic and extrinsic value limitations of intergenerational egalitarianism. For example, Beckman [43] suggests a ‘humanistic’ framework based on the priority of creating a decent society for future generations. However, this proposal reduces sustainability to a social dimension, relegating the environmental aspects to the mere background. Environmental studies have repeatedly demonstrated this to be a dangerous path [17].

Without exploring in detail the theoretical reasons for such appropriateness, it is relevant to mention that intergenerational sufficientarianism has the particular potential to foster sustainability and sustainable development [44]. Gardiner and Shue are examples of authors that sustain the opinion that individuals are entitled to carbon emissions necessary for some minimum level of wellbeing [45]. Other works of Shue reinforce the notion of sufficiency as specific sufficient conditions, with regard to human wellbeing, that will necessarily trigger political action to protect (future) people [46].

Most importantly, intergenerational sufficientarianism does not fall into the trap of an intangible and unreasonable equality of unsustainable life conditions (e.g., consumerism) but, on the contrary, advocates for a minimal (or reasonable) wellbeing.

I go further in supporting intergenerational sufficientarianism and defend its improved adequacy in the specific context of the SDGs. Intergenerational sufficientarianism responds far better to the uncertainty of future scenarios (distant future generations) and regional eco-socio-economic specificities because it allows differentiated threshold(s) of wellbeing.

In addition, intergenerational sufficientarianism stands for the individual wellbeing, within each generation, instead of focusing on the impersonal ‘aggregated good’, as in intergenerational egalitarianism and prioritarianism. The value of each person’s wellbeing is not lost in group definitions (e.g., ‘worst-off’) or in agglomerates of natural and social goods, which may or may not be decisive for human wellbeing (intergenerational egalitarianism).

Another merit of this theory is the facilitated translation of its justice principles in sustainable development criteria, i.e., it is not particularly challenging to apply this theory to concrete SDGs’ strategies. Additionally, it is possible to transform its axioms to practical parameters to include in the assessment of the SDGs targets (see Appendix B).

It is relatively straightforward to introduce and articulate minimum thresholds when contextualising (e.g., temporally, geographically) the majority of the SDGs targets. According to the nature of the SDGs and respective targets, minimum levels can be set as sub-targets. These levels can be quantitative (e.g., above \$1.25) or qualitative (e.g., basic services). Such minimal thresholds can be determined for both proximal and distant future generations (see Tables A4 and A5).

Tables A4 and A5 illustrate the possibility of reinforcing present generations' and future generations' wellbeing within the SDGs framework. The tables show sub-targets for SDGs 1: 'no poverty' and 7: 'affordable and clean energy' as examples of how SDGs can grant intergenerational distributive justice based on intergenerational sufficientarianism while preserving the wellbeing of present, proximal, and distant future generations. The proposed sub-targets can be part of (global and regional) implementation strategies for the achievement of the SDGs. In line with the justice frame of intergenerational sufficientarianism, one can find, in Tables A4 and A5, keywords such as *minimal*, *minimum*, and *basic*, as well as quantitative values (e.g., 95%, triple), which reflect sufficientarian thresholds.

As shown in Table 2, for example, the suggestion (for Sub-target 1.3) is that all individuals, firstly below minimum conditions, and afterwards below world-average living conditions, would be covered by social protection.

Table 2. Proposed intergenerational sufficientarian Sub-target 3, for Goal 1: end poverty.

Sub-Goal	Present, First, and Second Generations	After the Second Generation
1.3	By 2055, implement nationally appropriate social protection systems and measures so to cover all people living in what is and will be internationally agreed as <i>below minimum</i> conditions.	After 2055, implement nationally appropriate social protection systems and measures so to cover increasingly more people <i>below world-average</i> living conditions.

The integration and reinforcement of intergenerational sufficientarianism in the SDGs sub-targets will not generally change the intent of the original texts. However, in the case of sub-target 7.1 (see Tables 3 and A5), the purpose is to grant 'affordable, reliable, and modern energy services' [12] (p. 10), while what is proposed here is to guarantee that those energy services are provided to people at minimum cost. In this case, there might be a scenario when the cost of sustainable energy might still be too high for people living below certain living standards. However, there are social mechanisms (e.g., subsidies) that can ensure that non-universally affordable energy can be available to individuals with less economic power.

Table 3. Proposed intergenerational sufficientarian Sub-target 1, for Goal 7: affordable and clean energy.

Sub-Goal	Present, First, and Second Generations	After the Second Generation
7.1	By 2055, ensure access to reliable and sustainable energy services at <i>minimum</i> cost.	After 2055, continue the strategies that ensure access to reliable and sustainable energy services at <i>minimum</i> cost.

It is important to notice that threshold values used in Tables 2 and 3 and Tables A4 and A5 are solely indicative. Such values can set by social, scientific, and/or political agreement.

The suggested sub-targets have the added benefit of using the same indicators, or similar measures to the ones already defined, in UN documents. Overall, indicators would not change considerably, despite the changes in the targets' distributive and temporal justice frames.

These frameworks affect the level or value considered to be adequate (just), the targeted population (individuals below minimum conditions), and how long it is necessary to monitor a particular phenomenon (covering both present, proximal, and distant future generations). For example, in Goal 7: 'affordable and clean energy', Target 7.3 translates into the indicator 'energy intensity measured in terms of primary energy and GDP' [12] (p. 10). According to the suggestions, the indicator

would be the same. The change would occur in the analysis of the target. The objective would be attained when, in the first stage, energy efficiency would triple, and afterwards, if this efficiency would continue increasing until the practical maximum (see Table A5).

The implementation of intergenerational sufficientarianism for protecting and enhancing distant future generations' wellbeing can, de facto, facilitate decision- and strategy-making for sustainable development. Again, using Goal 7 as an example, a longer temporal framework (6–8 generations: 120–160 years) gives better guidance to what 'clean energy' and 'fuels' actually mean (see Table A5, Sub-targets 7.2 and 7a). In the case of decision-making based on environmental assessment tools, it is necessary to understand what timeline to consider when dealing with trade-offs between potential environmental impacts. As previously mentioned, in the case of energy technology, long-term environmental effects can be better managed with a plausible and justified quantitative notion of time.

Another advantage to the reinforcement of intergenerational sufficientarianism is the (possible) setting of evolving thresholds. As exemplified in Table A4, the poverty reduction targets (Goal 1) were established at the level of minimal and basic living conditions, for present and proximal future generations. Nevertheless, the aim for distant future generations is set higher: at world average. It can be argued that establishing evolving thresholds creates a positive direction for sustainable development while accommodating world socio-economic dynamics. The establishment of multiple thresholds can happen within a generation. As Widerquist writes, it is possible to establish lower and upper wellbeing thresholds so that society pursues the improvement of the worst-off people without disregarding the advancement of the ones that are better off [47].

An intergenerational sufficientarianism justice structure allows world targets and differentiated subsets of thresholds according to national and regional characteristics. The adoption of subsets of 'situational thresholds' has the added benefit of being a concrete answer to differentiated eco-socio-economic conditions, especially derived from past national rates of human development. Environmental and historical factors (e.g., colonialism, racial tensions, and natural disasters) affect not only present eco-socio-economic conditions, but also influence the conditions for future development. Through the implementation of 'situational thresholds', present and future individuals who live in areas where basic standards are higher than most poor regions, and yet do not reach the desired minimum wellbeing, are made morally eligible to benefit from additional help. As illustrated in Goal 1, Table A4, it is plausible and fairer to use such a differentiation strategy, because there are, at present, considerable national, regional, and local disparities in the vulnerability to poverty, which affect the present and future capacity of response.

The setting of global and regional baselines for wellbeing (e.g., poverty reduction) conveys the notion of moral obligation towards the elimination of the worst poverty circumstances in absolute terms. Additionally, it obliges us to improve localised and particular conditions that affect individuals below regional levels of minimal living conditions, in relative terms. For example, it seems undeniable that poor people in Dacca and New York need help to better their living situation, even if only the Bangladeshi destitute are below easily-recognisable minimal wellbeing situations.

Despite the positive aspects, the reinforcement of intergenerational sufficientarianism in the SDG discourse and praxis would not come without challenges. Presumably, the most difficult one would be the establishment and acceptance of 'basic' and 'minimum' standards. This requirement would trigger additional international discussion among nations' representatives and stakeholders. The positive aspect of a common reflection on fundamental conditions for any human being is the opportunity for increased societal engagement and reflection on concrete conditions for a fair future.

5. Conclusions

The SDGs are a timely opportunity for present generations to adopt a socio-economic development that guarantees the wellbeing of future people. Despite the unanimous acknowledgment of the relevance of fair distribution principles in the implementation of sustainable development strategies, distant future generations' requirements are not minimally ensured by the current formulation of the

SDGs. The short timeline of the SDGs mainly promotes a more equal division of very minimal goods (e.g., education, maternal health) among genders and countries of origin. Despite these flaws, the SDGs' agreement can still promote a steady increase in distributive justice for proximal and distant future people.

A mapping of the SDGs to three distributive justice frameworks shows that most SDGs reflect egalitarian and prioritarian principles. Since the objective is to increase distributive justice for current, proximal, and distant future generations, additional sub-targets are proposed and based on the principals of intergenerational sufficientarianism. SDGs 1: 'no poverty' and 7: 'affordable and clean energy' were used as examples of how targets can be specifically formulated under such principals. In general, the aim is to set (at least) two thresholds for each SDG target, corresponding to the two generational timeframes (until and after 2050). More importantly, the level of the proposed thresholds rises in time to guarantee that no individual falls below those lower limits, while ensuring a continuous growth in the overall wellbeing.

It is expected that including intergenerational sufficientarian principles, in the form of the suggested sub-targets, harmonises the longer developmental timeframe with the obligation of taking present action to safeguard sufficient wellbeing conditions for all present and future people.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Table A1 shows the distribution by goal of the temporal scale of the each UN SDG target.

Table A1. Results of the timeframe analysis of the SDGs targets.

	Goal	2017 (%) ¹	2020–2025 (%) ¹	2030 (%) ¹	No Time (%) ¹
1	No Poverty	-	-	71	29
2	Zero hunger	-	-	63	38
3	Good health and wellbeing	-	8	46	46
4	Quality education	-	10	80	10
5	Gender equality	-	-	-	100
6	Clean water and sanitation	-	13	75	13
7	Affordable and clean energy	-	-	100	-
8	Decent work and economic growth	-	25	25	50
9	Industry, innovation and infrastructure	-	13	38	50
10	Reduce inequalities	-	-	30	70
11	Sustainable cities and communities	-	10	60	30
12	Responsible consumption and production	-	9	36	55
13	Climate action	-	20	-	80
14	Life below water	-	50	10	40
15	Life on land	-	50	8	42
16	Peace, justice and strong institutions	-	-	17	83
17	Partnerships for the goals	5	5	5	84
	Totals	1	13	35	51

¹ The table values represent the relative frequency of each specific time period, in the totality of the targets of each goal.

Table A2. Summarises the results of the textual analysis regarding the relative amount of targets that include or not distributive justice principles. It accounts for both *intra*- and *inter*generational statements.

		Egalitarian ¹	Prioritarian ¹	Sufficientarian ¹	No Justice ²
	Goals	(%)	(%)	(%)	Statement (%)
1	No poverty	22	67	11	-
2	Zero hunger	43	57	-	25
3	Good health and wellbeing	31	31	38	-
4	Quality education	67	33	-	-
5	Gender equality	100	-	-	-
6	Clean water and sanitation	44	56	-	-
7	Affordable and clean energy	67	33	-	40
8	Decent work and economic growth	29	43	29	-
9	Industry, innovation and infrastructure	36	45	18	-
10	Reduce inequalities	50	30	20	-
11	Sustainable cities and communities	56	22	22	20
12	Responsible consumption and production	50	50	-	36
13	Climate action	50	50	-	20
14	Life below water	25	75	-	70
15	Life on land	33	67	-	75
16	Peace, justice and strong institutions	82	18	-	17
17	Partnerships for the goals	22	72	6	21
	Totals	46	43	11	20

¹ The initial sample of targets of each goal was sub-divided in two groups: targets with and without justice statements. The values represent the relative frequency of each specific distributive justice framework, in the group of targets with justice statements. ² The values represent the relative frequency of the group of targets without justice statements based on the totality of targets that concern each goal.

Table A3 shows the coding used to classify the 169 SDGs targets present in the list of Sustainable Development Goal indicators [12] into distributive justice theory classes.

Table A3. Detailed correspondence between keywords and concepts to distributive justice theories with examples taken from the SDGs targets.

Justice Theory	Keywords	Concepts	Examples in Target Statements
Egalitarianism	All; equal(ity); equitable; universal; full; inclusive, people everywhere	Universal (access/coverage); prevent all forms of discrimination/environmental impacts (e.g., acidification); full and effective participation; global justice, reinforcement of international law	'Prevent trade restrictions and distortions' (2.b); 'enhance international cooperation' (7.a); 'non-discriminatory' (16.b)
Prioritarianism	Poor; vulnerable, pro-poor; gender-sensitive; child soldiers; African countries; small island developing states; land-locked states/developing countries; marginalised communities	Developing countries; small scale food producers; least developed countries; specific population groups (e.g., youth, migrants); local communities; small and medium sized enterprises; promote sustainable practises; transnational companies; people/activities most affected by adverse environmental impacts	'Living in poverty' (1.b); 'the poor and the vulnerable' (1.3, 1.4), 'those/people in vulnerable situations' (6.2, 2.1); 'under 5 years of age (2.2)'; 'adolescent girls, pregnant and lactating women and older persons' (2.2); 'people suffering' (6.4); 'where the need is greatest' (10.b)
Sufficientarianism	Reduce/increase (the number); share; double; percent	End specific diseases, explicit minimum threshold (e.g., one-third)	'On less than' (1.1); 'at least as' (3.2); 'achieve higher levels (8.2)'; 'improve efficiency/progressively' (7.3, 8.4)

Appendix B

Tables A4 and A5 provide examples of intergenerational sufficientarian sub-targets that address present and future generations' proximal and distant wellbeing. For simplicity, only two goals (SDGs 1: 'no poverty' and 7: 'affordable and clean energy') were chosen as exemplificative samples of how SDGs can grant intergenerational distributive justice based on intergenerational sufficientarianism, to present, proximal, and distant future generations.

The proposed sub-targets were based on the SDGs text so as to portray, as accurately as possible, the intentions of the signatory countries.

Table A4. Proposed intergenerational sufficientarian sub-targets for Goal 1: ‘no poverty’, targeting present, proximal, and distant future generations.

Intergenerational Sufficientarian Sub-Targets	Present, First, and Second Generations	After the Second Generation
1	By 2030, eradicate extreme poverty for people currently measured as people living on less than \$1.25. From 2030 onwards, maintain and, if necessary, reinforce the eco-socio-economic strategies that prevent people from falling into extreme poverty.	From 2030 onwards, maintain and if necessary, reinforce the eco-socio-economic strategies that prevent people from falling into extreme poverty.
2	Between 2015 and 2055, steadily reduce, at least by half, the proportion of people living <i>below</i> , what is internationally agreed as being <i>minimum wellbeing</i> conditions.	After 2055, steadily reduce the proportion of people living <i>below world-average</i> living conditions.
3	By 2055, implement nationally appropriate social protection systems and measures so to cover all people living what is and will be internationally agreed as <i>below minimum</i> conditions.	After 2055, implement nationally appropriate social protection systems and measures so to cover increasingly more people <i>below world-average</i> living conditions.
4	By 2055, ensure that all people have access to <i>basic services, partial</i> ownership and control over land and other forms of property, inheritance, <i>basic rights</i> to economic, natural and technological resources and financial services, including microfinance.	After 2055, ensure that increasingly more people have access to <i>good quality</i> services, <i>more</i> ownership and <i>more</i> control over land and other forms of property, inheritance, rights to economic, natural and technological resources and financial services, including microfinance.
5	By 2055, build the resilience of those <i>living below minimal conditions</i> and reduce, at least 40% their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.	After 2055, build the resilience of those <i>living below or at world-average</i> conditions and reduce, each decade, at least 30%, their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
a	By 2055, ensure a 30% increase in the mobilisation of resources from a variety of sources, including through enhanced development cooperation, to provide adequate and predictable means to implement programmes and policies to end living conditions <i>below minimal standards</i> .	After 2055, ensure a steady increase in the mobilisation of resources from a variety of sources, including through enhanced development cooperation, to provide adequate and predictable means to implement programmes and policies to end living conditions <i>below world average</i> standards.
b	By 2055, create sound policy frameworks at the national, regional and international levels, to <i>eradicate poverty</i> , measured as less than 60% of the average national salary.	After 2055, ensure the application of policy frameworks at the national, regional and international levels, to <i>prevent the re-incidence of poverty</i> , based on based on the future measures of poverty.

Table A5. Proposed intergenerational sufficientarian sub-targets for Goal 7: ‘affordable and clean energy’, targeting present, proximal, and distant future generations.

Intergenerational Sufficientarian Sub-Targets	Present, First, and Second Generations	After the Second Generation
1	By 2055, ensure access to reliable and sustainable energy services at <i>minimum</i> cost.	After 2055, continue the strategies that ensure access to reliable and sustainable energy services at <i>minimum</i> cost.
2	By 2055, increase <i>no less than 95%</i> the share of renewable energy in the global energy mix guaranteeing <i>minimum</i> adverse effects for the environment and humans, in the short term (40 years).	After 2055, continue to increase the share of renewable energy in the global energy mix guaranteeing <i>minimum</i> adverse effects for the environment and humans in the short (40 years) and long term (minimum of 120–160 years).
3	By 2055, at least <i>triple</i> the global rate of improvement in energy efficiency.	After 2055, continue to improve the global rate of improvement in energy efficiency until it reaches the practical maximum.
a	By 2055, increase <i>at least 60%</i> international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology that guarantees minimum adverse effects for the environment and for humans in the short term (40 years).	After 2055, ensure a steady increase in international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology that guarantees minimum adverse effects for the environment and for humans, in the short- (40 years) and long-term (minimum of 120–160 years).
b	By 2055, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for countries below average development including small island states and landlocked developing countries, in accordance with national and international programmes of support.	After 2055, ensure that countries have access and deploy the best available sustainable energy services in accordance with national and international programmes of support.

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Paper IV



A Methodological Framework for Developing More Just Footprints: The Contribution of Footprints to Environmental Policies and Justice

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Abstract

The rapid growth of human population and associated industrialisation creates strains on resources and climate. One way to understand the impact of human activity is to quantify the total environmental pressures by measuring the ‘footprint’. Footprints account for the total direct and/or indirect effects of a product or a consumption activity, which may be related to e.g. carbon, water or land use, and can be seen as a proxy for environmental responsibility. Footprints shape climate and resource debates, especially concerning environmental strategies. However, in general, footprints hold a dichotomous producer–consumer perspective that is not unanimously accepted. In addition, the current footprinting system transmits a simplistic message about environmental responsibility that taints the justice debate and jeopardises the validity of policies based on them. Consequently, it is crucial to question who is (and should be) accountable for adverse environmental effects. It is also critical to investigate how the methodological characteristics of footprints shape and affect the efficacy of policies on climate and natural resources. This article examines these challenges, focusing on negative justice and policy implications resulting from assigning environmental responsibility to a sole agent. The article proposes, and morally justifies, the development of a footprinting method that includes justice parameters in an attempt to render fair results that are more meaningful for environmental action. The second objective is to establish the potential of this new framework to promote environmental responsibility and justice while facilitating policy-making. The suggested justice elements aim at turning footprints into a concrete environmental policy instrument framed under the value of environmental fairness.

Keywords Footprint · Environmental policy · Environmental justice · Climate change · Land use · Water use

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Introduction

Climate change coupled with other challenges such as the natural resource crisis creates the need for detailed information about present and future environmental scenarios. The way such scenarios are created influences their results, which in turn, shape policies that affect populations and groups differently. Thus, environmental scenarios structure policies that can create or sustain asymmetries either in terms of access to resources or in the management of climate change impacts. The scientific and ethical communities are called to the task of advancing not only scientifically solid methods of understanding the state of environmental affairs but also of creating fair assessment tools. Among other requisites, environmental assessment methods should make clear who is held responsible for environmental stresses, as well as to what degree (Finnveden and Moberg 2005). Only by attributing environmental impacts in this way can sustainable policies be put in place, and environmental justice promoted.

Environmental indicators are a key tool used in environmental assessment methods. These indicators were developed in direct response to the challenge of comprehending and quantifying human impact on Earth. Generally, an environmental indicator is ‘a parameter or a value derived from parameters that points to, provides information about and/or describes the state of the environment’ (OECD 2001). The advantage of using an indicator is the possibility of translating the state of a very complex system into humanly digestible information.

Footprints, such as resource and climate footprints, are important examples of descriptive environmental indicators since they attempt to characterise environmental states or changes of a particular environmental component. These footprints aim at e.g. accounting for GHG (greenhouse gas) emissions (via the carbon footprint), water use (via the water footprint) and the impact on land (via the land-use footprint). The footprints considered are resource and climate footprints, calculated using data organized in MRIO (multi-region input–output) tables. Footprints are commonly applied to describe the impact of humans on ecosystems, i.e. they attribute environmental impacts, emissions or resource consumption to economic activity. Traditionally, the environmental justice debate around resource use is associated with differential access to and quality of resources according to geographical (Cutter et al. 1996), gender (Ahlers and Zwartveen 2009), social (Jenerette et al. 2011) or generational boundaries (Martinsen and Seibt 2013; Vasconcellos Oliveira 2018). In order to address such topics, it is invaluable to know the state of affairs of resource use and distribution. Furthermore, correct information about resource scarcity helps in developing concrete strategies to reduce inequality.

Footprints integrate the scientific discourse that stretches from subjects of economy (Ferg 2003) and life sciences (Wilting et al. 2017) to engineering (Lawlor and Morley 2017). Since footprints are commonly used to support and promote particular scientific, engineering and behavioural options, these particular indicators are relevant tools for scientific dissemination (Lee 2015; Milford et al. 2013). Additionally, footprints are communication instruments to a wider

audience (Hammond 2007) with a concrete influence on public opinion (Care2 2018). For example, both scientific networks (Global Footprint Network 2018a, b) and NGOs use footprints as tools for increasing environmental awareness in citizens, companies and economic sectors (WWF 2018; Greenpeace International 2017).

Footprints are neither morally neutral indicators nor used impartially in environmental discourse (Martinez-Alier et al. 2014; Nerlich and Koteyko 2009). Nonetheless, the development and use of footprints are highly politicised, influencing the sustainability dialectic about resources and environmental impacts (European Commission 2008; EPA 2017). Footprints are thus both scientific instruments and policymaking tools, and integrate the justification for environmental policies as an important interface between scientists and politicians (European Commission 2016). Information derived from footprint accounting, both directly and indirectly, influences policies which affect nations and communities differently, laying the ground for environmental (in)justice. This is the case for environmental impact accounting and potential taxation in the European Union (EU). As Ekins et al. (2011) note, a considerable number of European households would need additional support to overcome the negative economic impacts of an environmental tax reform. Similar conclusions hold for carbon taxation on disadvantaged population groups (Dennig et al. 2015). Another example of the prominence of footprints in political discourse is the EU's Sustainable Consumption and Production Action Plan (European Commission 2008). The EU Commission established this methodology for product and sector environmental assessment and looks for further interconnection of footprints with environmental EU strategies. Furthermore, the European Commission supports the use of footprints as instruments of communication on environmental performance (European Commission 2016). In the North American context, footprints are not so relevant politically; nevertheless, the US Environmental Protection Agency (EPA) supports sustainable development initiatives that are based on their information (EPA 2017). On a global level, there is the example of several indicators for the United Nations (UN) sustainable development goals which are footprints (e.g. indicator 8.4.1. material footprint) (UN 2016). All in all, the application of footprints both in policy and science underscores ethical tensions that should be addressed not only by the agents who generate information but also by those who use it: i.e. scientists, engineers and politicians.

One relevant ethical ramification of utilising footprints is the consideration of environmental responsibility. In the environmental justice tradition, environmental responsibility is attributed to a wide variety of agents (Schlosberg 2009; Monsma 2006; Middlemiss 2010). However, with the extensive and continuous application of footprints to climate and resource debates (Hayward 2006; Kolers 2012; Terry 2009), particular agents are often singled out as directly accountable for the source use and/or impacts, diverting attention from other possible actors. This creates additional environmental responsibility asymmetries that then affect nations and societal groups differently. For this reason, it can be argued that scientists and engineers are morally responsible for the implications of the environmental impact tools they use in their research.

So far, environmental and justice indexes developers have been more sensitive than indicator creators to the argument of designing environmental quantitative measures that include environmental justice elements. Sets of indicators and indexes have been elaborated that focus on specific targets, such as sustainable energy (Davidsdottir et al. 2007), environmental quality (e.g. Environmental Performance Index) and human wellbeing (Prescott-Allen 2001). In other cases, indexes were created to quantify more general concepts such as sustainable development (e.g. Eurostat Sustainable Development Index). Nevertheless, as Sarah Fredericks (2013: 351) notes, there is not a single index that includes all significant environmental, social and economic elements and allows monitoring of the distribution of environmental benefits or burdens within a nation or community. Thus, at the current state of development, indexes cannot portray a complete picture of environmental justice in the landscape of nations and communities. The same is true with sets of indicators. Nevertheless, when applied in particular contexts, sets of indicators provide relevant data that help to successfully describe and assess specific justice dimensions such as vulnerability to environmental factors (e.g. relating to climate or pollution).

Nevertheless, despite providing more specific (and limited) information when compared with indexes or sets of indicators, sole environmental footprint indicators still have great policy potential. They can contribute to a more accurate and nuanced picture of the present and future distributive situations. However, if calculated without justice concerns, they contribute to the perpetuation of distributive and environmental unfairness (Fredericks 2013). Footprints are therefore well-suited for assessing the (national and regional) provenance of present (and future) emissions, impacts or resource uses, and for pinpointing the agents responsible for those effects. A more just distribution of the encumbrances of environmental change and the setting of balanced emissions, impacts and resource uses depends directly on the results from environmental indicators. It is reasonable to state that societal action and policymaking based on accurate information helps (re)establish the grounds for distributive justice. Distributive justice here concerns the division of benefits and burdens among citizens. The justifications for such distribution are based on moral arguments which serve to guide political processes and structures (Roemer 1998). Environmental, climate and resource justice are only possible if policies and societal action adequately address scientific evidence. Conversely, for scientific conclusions to be properly integrated into the environmental discourse, it is vital to understand the ethical implications of the methods currently used in sustainability assessment, or there is a risk for misinterpretation.

In this article, one of the key arguments is that environmental assessment—in this case, via the footprint method—shapes environmental policies and societal actions. This is considered under the polarised debate on climate and resource use within the context of environmental justice (Schlosberg and Collins 2014). More just methods of assessing the state of resources and of the environment have the potential to steer policies towards increased environmental justice, which is needed in the areas of climate and resource use (Figuroa and Mills 2001, Schlosberg and Collins 2014). Socio-political actions, such as a resource tax, have the potential to favour either the disenfranchised or sustain current environmental and social inequalities (Crisp and Jamieson 2000). Both the developers of footprint accounting methods (e.g. natural

scientists, economists) and the users (e.g. engineers, politicians) are morally responsible for the outcomes of actions based on the numbers generated by footprints. Consequently, they are morally obliged to develop and apply methods of environmental assessment that provide a more correct picture of reality and give the correct extent of responsibility to the correct agents. As Fredericks (2013: 6) writes, some indexes theorists have recognized that normative priorities play a role in index development and a few authors even recognize the need to consider different ethical perspectives in this development. The same reasoning can be applied to indicators and to those who work with them and on their development.

This article goes beyond the examination and exploration of the justice and policymaking implications of footprints, and establishes ethical principles for the development of a renewed framework. Contrary to the ‘multiple accounting’ that Steining et al. (2016) suggest (for carbon accounting), proposed here is a single novel theoretical framework for assigning environmental responsibility framed by justice concerns. The aim is to establish a procedural framework for footprint calculation based on justice grounds. Here, the article assumes a broad interpretation of environmental justice which integrates the classical distributive (Shrader-Frechette 2002) and participatory issues (Figueroa and Mills 2001), and also includes developmental and global facets (Schlosberg 2009). In the case of developmental justice, it includes (climate and resource) conditions and models for the fair socio-economic development of nations and individuals (Ray 1998) and in the case of global justice it includes the national and the supra-national (climate and resource) justice dimensions, and their relations and interactions (Pogge 2001). The ultimate objective of this article is to make footprints a morally sound (just) tool for environmental responsabilisation of agents, and to strengthen the influence of scientific information in developmental, global and distributive justice contexts.

The Justice Repercussions of Using Footprints

Footprint calculations can be divided into two types: production-based and consumption-based. Each supports both scientific (Weinzettel et al. 2013; Steen-Olsen et al. 2012) and policy discourses on sustainability (UNESCO 2009; UN PBSO 2012), with a direct impact on environmental justice debates, especially in relation to global justice and distributive inequalities (Hayward 2006). However, within these categories, footprint calculation can differ a great deal (Hoekstra et al. 2011; Wiedmann and Minx 2008) which means that results and conclusions can vary significantly. These differences can lead to contrary discourses about who (individually and collectively) should change and support actions to mitigate and prevent further environmental degradation. Striking illustrations of how footprints have controversial results and applications are, for example, the discussion around the (non-) inclusion of rain-fed agriculture in water footprint accounting (Aldaya et al. 2010) or the inconsistency of metrics of the same footprint (Hoekstra 2016). Land and carbon footprints are also not immune to contentious disputes affecting the acceptability of their results in wider environmental impact debates, for example concerning the

emissions of toxic substances that are not related to climate change impacts, or lack of applicability in governance issues (Laurent et al. 2012; Kaphengst 2014).

The aim in what follows is to make clear which agent is held responsible for environmental effects when employing footprints and the ramifications for environmental justice of footprint accounting. The determination and evaluation of an agent's responsibility for their actions (justice agency) and the potential for mitigating or eliminating environmental impacts depend directly on a common understanding of what footprints actually determine. The ethical implications of adopting current calculation methods for developmental and global justice are also addressed, in an attempt to provide a rationale for the development of a different footprint methodology. For expediency, only carbon is used as an example since land and water footprints can also be calculated by both accounting methods.

The Responsibility Duality: Producers as the 'Scapegoats'

Production-based accounting sets system boundaries within a geographically or organisationally defined area, meaning that only the use, emissions and/or impacts coming from activities within those frontiers are included. Production-based footprints thus account for uses, impacts and/or emissions that occur directly during production or operation of goods or services but not in the supply chain. This accounting method allocates the environmental (resource use, emissions or impacts) responsibility solely to the agent that originates energy, goods or services, i.e. exclusively to the producer. The approach is favoured by several international institutions such as the Intergovernmental Panel on Climate Change (IPCC) or the World Resources Institute (Garg et al. 2006; WRI and WBCSD 2004). The Kyoto Protocol also sanctioned this approach (for CO₂). Every nation reports their GHG emissions to the United Nations Framework Convention on Climate Change (UNFCCC) under the production-based accounting approach (Garg et al. 2006; UNFCCC 2004); the emissions are consequently the basis for international global (carbon) targets.

It is argued here that the application of the production-based principle has created a significant political effect in the way nations are perceived, particularly because it is now clear that some countries may hardly (or ever) be able to achieve the international established carbon targets (Munksgaard and Pedersen 2001). This situation creates the risk of decreased international support to such nations in the case of environmental disasters, especially related to climate change, and leads to stigmatisation of developing countries with an economy based on carbon (and/or resource) intensive manufacture. If there is 'evidence' (e.g. national carbon footprints) that these countries are main contributors to the phenomenon of global warming (Hertwich and Peters 2009), the chances of international solidarity can dramatically diminish. Moreover, international aid agencies have a far more difficult task justifying support to these victims when there are many other countries in distress that apparently have not "caused" their own misfortune. Furthermore, as demonstrated in the literature, the societal groups most affected by environmental catastrophes are also the ones suffering most from socio-economic inequalities (Field et al. 2012). Countries such as China have increased the

general level of their population's wellbeing mainly through the creation of jobs in or related to industries with high environmental impact (Elliott and Shanshan 2008). This job creation was concentrated in some nations and regions, while some population groups economically deprived gained new sources of income due to such industries. Consequently, the wellbeing of these groups is highly dependent on industries that are major sources of environmental impact.

The method also leads to the rapid change in environmental impact profiles of nations in the last years, mainly associated with carbon. Scientists suggest that the course of international policy on climate, triggered by production-based carbon accounting, induces 'carbon leakage' (Eichner and Pethig 2011; Reinaud 2008), i.e. the phenomenon where businesses, due to increased costs related to climate policies, transfer production to countries with laxer constraints on GHG emissions. As Reyer Gerlagh and Onno Kuik (2014: 386–387) show, in an optimistic scenario, "the rate of carbon leakage is 9.5%; 40% of the relocated CO₂ emissions leak to developing countries, 34% to OECD countries, and 26% to countries of the former Soviet Union." The EU has concerns about this phenomenon since it can potentially lead to an increase in global emissions, and is a problem in key energy-intensive industries (European Commission 2018).

Evidence shows that during the last decades, many polluting and/or resource intensive industries indeed moved from richer countries to developing nations, reinforcing the idea that stricter environmental policy causes the delocalisation of such industries (Jänicke et al. 1997). There is a serious shift in the national emissions profile of nations that are committed to the Kyoto protocol as demonstrated by Barker et al. (2007) for the EU primary aluminium sector, and by Aichele and Felbermayr (2015) through bilateral trade. Kyoto protocol abiding countries have increased the importation of goods and services that were produced with high carbon emissions. These imports come from non-committed countries. By trading this way, Kyoto protocol abiding countries increased the emission intensity of their imports (Aichele and Felbermayr 2015). Meanwhile, other footprints of developed countries (e.g. EU) have also decreased and allowed some of them to reach their targets. Nevertheless, the real reason behind their 'success' may sometimes be defined as 'pollution' leakage (Paltsev 2001).

Assuming 'carbon leakage' and 'pollution leakage' to be true, there are relevant justice implications in addition to the environmental ones (Smarzynska and Wei 2001). Delocalization of heavy carbon emitters generates negative (local and regional) social (Pickles and Smith 2010) and economic effects (Dunford et al. 2013), in developing and developed countries. This situation deepens international developmental asymmetry and fuels environmental injustice. In an attempt to dampen the effect, for example, the EU has adopted carbon emission allowances for several industries (e.g. energy) to favour the decarbonisation of the European economy (Lund 2007). In general, the policies originated and adopted target the productive sector and not directly the citizens affected by this phenomenon (e.g. unemployment). Consequently, general doubts (and doubts specific to justice concerns), continue to grow among scholars and policymakers about how countries can and/or should contribute to the common effort to reach global

targets if they are calculated by production-based accounting, especially in the case of developing nations (Weber et al. 2008).

In addition to the justice limitations mentioned above, there are other fairness ‘challenges’ associated with the production-based accounting footprint. The principle of environmental accountability assumes that manufacturers have the scientific and/or technologic possibility to continually improve production processes. It also assumes that manufacturers can apply ‘greener’ production methods at a relevant scale while satisfying a growing need for products and services. This assumption disregards the factual challenges in technology transfer between nations and industries. As Avgerou and Walsham (2017) write, technology and knowledge transfers are particularly difficult when developing countries are the recipients. Furthermore, production-based footprint accounting presupposes increasing resource and/or energy efficiency. However, in many cases (e.g. steel), the technological limit is practically reached (Milford et al. 2013) proving such technologic optimism to be excessive.

To date, most environmental and socio-economic policies and potential measures (e.g. EU carbon emission allowances, ‘carbon tax’) have originated as a consequence of production-based accounting (e.g. production-based carbon footprint), which offers a matrix of justice considerations, especially regarding how to fairly prevent increased inequality deriving from ‘carbon’ offsetting measures (Böhringer et al. 2012). In sum, there are many justice implications and limitations that hinder production-based accounting in terms of being a just approach to determine environmental responsibility.

The Responsibility Duality: Consumers as the New Environment Culprits

In a consumption-based footprint, the inventories include a value chain perspective, i.e. the system boundaries are open. Here, the data includes resource use, emissions and/or impacts caused by the production of goods and services consumed by the organisation or nation in question. This inclusion is independent of whether the resource use emissions and/or impacts occur inside or outside the organisational limits of the population or activity of interest. This footprint accounting method includes all the emissions, uses and/or impacts along the supply chains (Cazcarro et al. 2010; Larsen and Hertwich 2009). The justice consequence of this system boundary change is that consumers are ultimately responsible for any environmental impacts of the goods, services and energy imported from outside national borders and consumed in each country (Munksgaard and Pedersen 2001). As such, consumption-based accounting assumes the consumer is fully responsible for all the emissions, uses and impacts of the entire value chain.

Research has shown contrasting world trends in terms of carbon emissions: emissions embodied in trade have rapidly increased, whilst the gap between production emissions and the emissions associated with consumption have widened (Barrett et al. 2013). As Bastianoni et al. (2004: 255) warn: “without adequate incentives or policies, consumers are not likely to be sensitive [...] to their environmental

responsibilities, having, in fact, no consumption limits.” The fact that there is a positive correlation between consumption-based emissions and GDP (gross domestic product) (Lee and Lee 2009), makes this accounting method seem (more) just.

In comparison to production-based accounting, consumption-based accounting is more recent, so there are increased opportunities for methodological improvements (Afionis et al. 2017; Barrett et al. 2013). Nonetheless, the consumption-based principle has several flawed presuppositions. Firstly, it assumes that all consumers have access to environmental information about products and services. Secondly, it assumes that consumers understand such information, and thirdly, that they can actually choose the best alternatives. Making better choices requires the availability of ‘greener’ products, and populations must have the buying power to purchase the ‘greener’ alternatives. The third assumption disregards individual factors like personal indecision and incapacity to decide about trade-offs between resources, impacts and/or emissions. The prerequisites for shifting towards ‘greener’ consumption are particularly difficult to find in developing countries (due to e.g. price and availability constraints). Even in developed nations, there are cases where environmental education and environmental consciousness are not sufficiently developed in citizens to drive such transition (Franzen and Meyer 2010; Palmer et al. 1998), and in many cases, citizens from countries with high GDP do not know enough to make greener choices (see Tables 1 and 3). Consequently, it is reasonable to claim that it is unfair to centre the responsibility solely on the individual when there are significant socio-economic factors influencing the actions of consumers.

The consumption-based principle (and footprint)—of responsibility of the end consumer—relies on the general premise that the production of goods and services is (mainly or solely) driven by consumer demand. Such postulation is challengeable on the grounds of consumers ultimately not having the (full) capacity to be the ‘invisible’ hand, powerful enough to shape markets and turn them fairer and greener. If this were to be true, for instance, ocean oil spills would no longer exist due to the extensive environmental campaigns and public voices against this occurrence. Furthermore, even if improvements were to be made, consumption-based accounting would not become fairer as the basic accounting principle would not be altered: the end-consumer bears total responsibility. Table 1 describes briefly some inadequacies of production and consumption-based footprints focused justice issues.

Sharing The Burden of Environmental Responsibility

As mentioned previously, both producer and consumer-based footprints have conceptual and justice limitations that hinder their results from being used in the wider contexts of environmental policymaking and environmental justice. However, despite described limitations, production and consumption calculation methods can still be relevant in pinpointing emitters and emissions fluxes. Using this information, new improved footprint accounting methods should be developed to target the question of environmental responsibility.

This article proposes an alternative approach to footprint calculation based essentially on the premise that footprints are policy-informing tools, attributing

Table 1 Relevant moral limitations of production and consumption-based footprints

Characteristics	Production-based footprint	Consumption-based footprint
System frontiers and description	Incomplete: missing value chain associated emissions and global trade impacts ‘Supply-driven’ perspective of economy	‘Demand-driven’ perspective of economy
Justice agency	Personal responsibility for environmental impacts overlooked	Low or no accountability of companies and institutions Omission of relevant socio-economic factors that influence consumer behaviour
Developmental justice	Over-representation of manufacturing-intensive countries compared to post-manufacturing service economies (e.g. China vs. UK) Support of institutional barriers to the achievement of international (carbon) protocols affecting predominantly developing countries (e.g. China, India, and Indonesia)	Undervaluing of political and institutional efforts to create a low impact economy (e.g. decarbonisation of industries)
Global justice	Exacerbation of North–South gap rhetoric: the Global North is seen in a positive light at the expense of the Global South (e.g. land use)	Assumption of an ‘ideal market’ Potential misrepresentation of ‘non-trading’ economies due to lack of ‘greener’ consumption alternatives/substitutes (e.g. Cuba)

environmental responsibility to both companies and citizens. Responsibility is here understood as accountability for the adverse effects coming from free and rational choices. It is thus argued that both consumers and producers have an environmental responsibility since they can both negatively affect the environment through their choices (Fahlquist 2009). The responsibility is shared because the two actors contribute to single harmful outcomes (e.g. CO₂ emissions, land, and water depletion). It is also shared because the contributions of each agent (consumers, producers) cannot be attributed to them based solely on causation. For example, the carbon emissions, land and water uses of the agricultural sector (producer) do not exist entirely due to individual (consumers) demand since this sector generates more food than is consumed. At the same time, carbon emissions and land and water use from consumption of certain food products (e.g. meat in Asia) are constrained by low production capacity. Furthermore, the responsibility of consumers and producers for their impact is distributed to them separately, rather than resting on them collectively, i.e. there is no meaningful eco-socio-economic collective entity that integrates both consumers and producers and, at the same, is responsible for the environmental impacts.

There are several ways of performing a shared production–consumption footprint (Rodrigues and Domingos 2008; Ferng 2003; Kanemoto et al. 2011). Due to the scope of this article, the different alternatives are not mapped exhaustively. As in the case of production-based or consumption-based accounting footprints, the majority

of the methods for a shared production–consumption based footprint were developed for carbon. Nevertheless, there are no methodological impediments to use this approach for land or water footprints as well. Jiun–Jiun Ferng made one of the first attempts at designing a shared production–consumption footprint. In this case, the elements for calculating each agent’s share of the emissions are the consumption–benefit principle and the ecological deficit. The consumption–benefit principle states that the division of responsibility should be negotiated internationally while taking into account differences in national economic structures, consumption patterns and levels, and equal basic needs at a per capita basis. The ecological deficit quantifies the overuse of resources or the excess of emissions. The difference between human requirements and the carrying capacity is the footprint result (Ferng 2003). Another perspective for a shared production–consumption method was introduced by Pontus Cerin (2006) and Cerin and Karlson (2002). In these cases, the sharing parameter for each agent was calculated according to the degree of its influence over a value chain or benefit derived from any particular transaction. In 2007, Manfred Lenzen developed this approach further, but with a new focus on the economic opportunity of producers and consumers in engaging in economic transactions by means of division of responsibility (Lenzen 2007). In other words, responsibility for use, emissions and/or impacts was allocated differently, according to the added value of each element in the value chain. In any case, the methodologies presented so far do not have a strong theoretical justification i.e. the reasoning behind responsibility allocation is either arbitrary (Zaks et al. 2009; Lenzen 2007) or one-dimensional justifications traceable to economics (Cerin and Karlson 2002). Nonetheless, they demonstrate that there is the (mathematical) possibility of an improved accounting method that overcomes the limitations of the production and consumption-based footprints.

So far, there has not been a true discussion among the scientific community and the relevant stakeholders about the principles that should inform the division of responsibility. There is a strong possibility that under the prevalent economic perspective (Murphy et al. 1989; Rosenstein-Rodan 1943), shared responsibility approaches may not find new supporters, as confirmed by the lack of significant methodological advancements in recent years. Additional developments of this type of accounting method may well be more dependent on the evolution of economic, policy and justice concepts than on scientific progress.

Justice elements for improving footprints

To generate an improved measure of environmental responsibility, it is necessary to look beyond the mathematical possibilities (shared production–consumption method) and search for the justice elements that can and should be incorporated. Since allocation responsibility implies, among other things, fair methods and results, developing a method based on a clear theoretical body of ethical work about justice seems a natural path. What is proposed here is the adoption of a shared production–consumption based accounting matrix, with coefficients of environmental responsibility of the agents based on justice reasons. So far, the stand is (sole) economic value dictating the share of environmental accountability (Lenzen et al. 2007;

Kanemoto et al. 2011; Cerin 2006; Ferng 2003) which can be seen as a gross oversimplification. There are factors that determine the agent's responsibility which go beyond economics and extend to the moral (justice) sphere (Fischer and Ravizza 1998; Forsyth 1992).

The following proposed theoretical framework is an opportunity to start a consistent and grounded discussion about the premises which should be behind a just environmental responsibility allocation. The framework suggested here has the novelty of integrating the specificities of the agents in their national contexts, i.e. the 'just allocation' of responsibility should be calculated according to specific characteristics of producers and consumers of each nation. Figure 1 represents how, in footprints, environmental responsibility can be theoretically divided among the agents. To overcome the limitations of the accounting methods, 'just' footprint includes (all) the agents responsible for environmental impacts and resource use while contextualising the capacity of producers' and consumers' to consider and/or change to better environmental alternatives. Table 2 describes the characteristics of 'just' footprint in response to the justice limitations of production and consumption-based accounting footprints.

Table 3 enunciates the moral justification for the inclusion of the parameters integrated in the 'just' footprint calculation framework. These parameters derive from the concept of environmental justice described in the introduction and focus on the factors that (can) directly affect the agents involved (producers and consumers). It is important to make clear that 'producers' and 'consumers' are defined and understood here according to the tradition of input–output analysis (Miller and Blair 2009). The suggested parameters do not exhaust the justice implications for individuals and groups seen under other traditions, such as climate and environmental justice. For example, they do not tackle the disproportionate burden of climate change on racially-diverse communities. The parameters included in the 'just' footprint calculation are 'adjusted' to the characterisation of input–output national accounting of these categories. In input–output analysis, the industries and service sectors employing economic activities are considered 'producers' while 'consumers' aggregate households and government levels. Note that for the purposes of production, producers utilise goods and services from other producers and therefore can also be regarded as (intermediate) consumers in the input–output model (Miller and

Fig. 1 Representation of environmental responsibility attribution in the footprint method

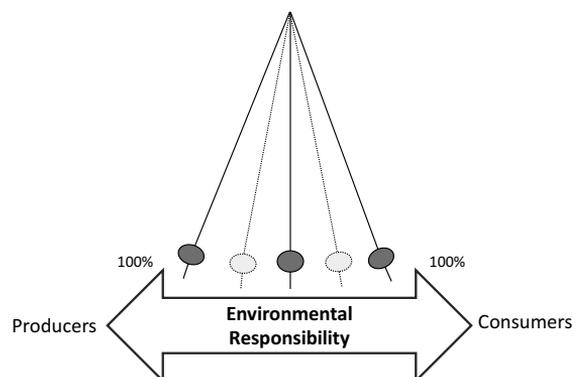


Table 2 Justice characteristics of production-consumption based ‘just’ footprint

Justice limitations of footprint accounting	Production-consumption based ‘Just’ footprint
System frontiers and description	Inclusion of emissions, impacts and resource use embodied in trade Recognition of mutual influence of production and consumption in global trade
Justice agency	Contextualized shared responsibility for environmental impacts, emissions and resource use Integration of relevant socio-economic factors that influence producer action and consumer behaviour
Developmental justice	Integration of eco-socio-economic factors
Distributive justice (nations and individuals)	Incorporation of indicators of a nation’s wealth and individual income disparity
Global justice	Increased neutrality towards different socio-economic models

Table 3 Justification for inclusion of parameters in ‘just’ footprint calculation

Agent	Parameter	Justice justification
Producers	Technological improvement capacity	Institutional obligation of (re)-design towards improved (environmental) justice standards (Rawls 1971)
	Technological sectorial improvement capacity	The economic possibility of production sectors to use the best available ‘greener’ technology (Van Marrewijk 2003; Dahlsrud 2008)
	Availability of ‘greener’ substitute goods for production	The existence of alternatives is pre-requisite for (re)-design towards improved (environmental) justice standards (Rawls 1971; Cohen 1989)
Consumers	Environmental awareness	The individual <i>sense of justice</i> is the base of consistent decisions in the quest of what is just (Rawls 1971). Education has the mandate to strengthen justice and environmental awareness (and action) (Apple 2009)
	Purchasing power	Monetary resources are pre-requisite for acquiring products. Low/deficient economic resources diminish the freedom to act accordingly to justice principles (Rawls 1971; Glickman 2009)
	Availability of ‘greener’ substitute goods for consumption	The existence of alternatives is a pre-requisite for free, reasonable and rational choices (Rawls 1971)

Blair 2009). The nature of such definitions greatly narrows the environmental justice implications that can be associated with these categories since they need to be quantifiable and the data need to be available in the input–output national accounting system.

In practical terms, in the proposed ‘just’ footprint, the environmental responsibility quota of each agent is defined according to the theoretical and practical possibility of

producers and consumers to diminish their impacts, emissions or resource use, framed by the eco-socio-economic conditions of each nation or territory. It is proposed that the producers' environmental responsibility, calculated via a 'just' footprint, should be a function of the (1) technological improvement capacity, (2) technological sectorial improvement capacity and (3) availability of 'greener' substitute goods and services. In the case of consumers' environmental responsibility, it should be calculated as a function of the (1) general environmental awareness of the population, (2) their purchase power (corrected by the inequality level) and (3) availability of 'greener' substitute goods and services.

In other words, the 'just' footprint combines measures which go beyond the systems of national accounts parameters and includes others that ensure a fair characterisation of the system. By doing this, the greatest strength is to account not only for what the agents are using, impacting and emitting ('classical' footprint) but also what they are capable of, and willing to improve in their environmental performance, in real life situations, which is the national context where they operate. It seems unreasonable to directly blame the consumers of an impoverished and/or underdeveloped nation for environmental impacts if they can only afford to buy the most readily available and cheapest items, which might be originated from 'dirty' production methods. The same reasoning holds for companies that cannot access the best technology of production because they operate in a country tarnished by war or under international sanctions. Table 4 shows the parameters used in the 'just' footprint for calculating carbon emissions, water and land use. Potential indicators or indexes that can operationalise the parameters are suggested for each one of the parameters. Some of the indicators can be associated with developmental (e.g. gross fixed capital formation) and environmental justice (environmental awareness index) and environmental vulnerability (water exploitation index). Since the 'just' footprints are to be calculated per nation, the proposed indicators and indexes pertain to accounts available to countries.

Method

This section describes how a 'just' footprint can be calculated. Although a full implementation of the concept is outside the scope of this article, a simple example is presented to illustrate a potential implementation.

Suppose a two-region economy. Each of the regions has the same number of economic sectors and the regions trade goods and services with each other. The production-based footprint F of either of the regions is given by the sum of emissions associated with production for domestic consumption, emissions associated with production for export, and emissions by final demand sectors such as government and households:

$$F_n^{prod} = F_n^{dom} + F_n^{exp} + F_n^{fd} \quad (1)$$

From a consumption perspective, emissions are accounted for via summing domestic emissions, emissions embodied in the imports, and emissions from final demand sectors.

$$F_n^{cons} = F_n^{dom} + F_n^{imp} + F_n^{fd} \quad (2)$$

Table 4 Parameters, indicators and indexes included in 'just' footprint calculation

Agent	Footprint parameter	Resource/environmental impact		
		Carbon	Water	Land
Producers	Technological improvement capacity	¹ Lowest carbon intensity production chain	¹ Lowest water use and aquatic pollution production chain (incl. blue* and grey water**)	¹ Lowest land use
	Indicator(s)/index(es)	GHG emissions	² Water exploitation index ^a ² Water quality index ^b	Artificial land or built-up area ^c
	Technological sectorial improvement capacity	Economic sectorial capacity to invest in technological improvement		
	Indicator(s)/index(es)	Gross fixed capital formation (as percentage of GDP) ^c		
Consumers	Availability of 'greener' substitute goods and services	Technology transfer capacity		
	Indicator(s)/index(es)	Import/export restrictions		
	Environmental awareness	Import partner share ^e		
	Indicator(s)/index(es)	FDI and technology transfer ^f		
	Indicator(s)/index(es)	Degree of recognition of global warming	Degree of recognition of water scarcity and pollution	Degree of recognition of land misuse
	Purchasing power	³ Education index ^g		
	Indicator(s)/index(es)	³ Environmental awareness index ^h		
	Availability of 'greener' substitute goods and services	Economic capacity of individuals and/or households to buy 'greener' goods and services		
	Indicator(s)/index(es)	Purchase power parity (GDP _{PPP} /cap) ⁱ		
	Indicator(s)/index(es)	Degree of economic openness		
		Openness to trade ^j		

Table 4 (continued)

*Blue water is the 'surface water and groundwater required (evaporated or used directly) to make a product' (Grace Communications Foundation 2016)

**Grey water is 'the amount of freshwater required to mix and dilute pollutants enough to maintain water quality according to governmental standards (e.g. US Clean Water Act) as a result of making a product' (Grace Communications Foundation 2016)

¹Benchmarked against the best (current) production example within each sector, i.e. the country whose production sector has the lowest impact/resource use is used as the example of improvement potential for the rest of the countries

²An established water pollution index was not found in the literature

³Established indicators or indexes concerning the social awareness of global warming, water scarcity or land misuse were not found in literature

^a(Lallana and Marcuello 2004); ^b(Harkins 1974); ^c(Gijjum et al. 2013); ^d(The World Bank 2018a); ^e(WITS 2018a); ^f(UNDP 2018); ^h(Kokkinen 2014); ⁱ(The World Bank 2018b); ^j(WITS 2018b)

Note that in a two-region economy, the export from region 1–2 equals the import from region 2–1 and vice versa. This implies that the consumption-based footprint for region 1 can be re-written as follows:

$$F_1^{cons} = F_1^{dom} + F_2^{exp} + F_1^{fd} \tag{3}$$

As emissions associated with production for both domestic consumption and emission associated with final demand remain equal, it is clear that the difference between consumption and production perspective lies in the treatment of emissions embodied in the trade flows between the two regions. Therefore, a ‘just footprint’ should aim for a re-allocation of these embodied emissions to each of the regions, to represent a shared production-consumption perspective. One such allocation could be the following, where part of the emissions embodied in exports and part of the emissions embodied in imports are allocated to both regions.

$$F_1^{just} = F_1^{dom} + \alpha F_2^{exp} + (1 - \beta) F_1^{exp} + F_1^{fd} \tag{4a}$$

$$F_2^{just} = F_2^{dom} + \beta F_1^{exp} + (1 - \alpha) F_2^{exp} + F_2^{fd} \tag{4b}$$

The crux to a just accounting framework lies in a proper establishment of the weights α and β presented in Eq. 4. Note that these weights can be established from both a producer perspective (i.e. through exports) and consumer perspective (i.e. through imports) and both perspectives should be included in the calculation of weights α and β .

In Table 4, several indicators were presented that reflect various aspects of consumer or production accountability. In more general terms, one could think of i consumption perspective indicators C , and j production perspective indicators P , for respectively region 1 and region 2. α and β can subsequently be defined as follows:

$$\alpha = \frac{\sum_i C_1^i}{\sum_i C_1^i + \sum_j P_2^j}; \quad (1 - \alpha) = \frac{\sum_j P_2^j}{\sum_i C_1^i + \sum_j P_2^j} \tag{5a-5d}$$

$$\beta = \frac{\sum_i C_2^i}{\sum_i C_2^i + \sum_j P_1^j}; \quad (1 - \beta) = \frac{\sum_j P_1^j}{\sum_i C_2^i + \sum_j P_1^j}$$

Note that a normalization of the indicators might be required to ensure that all indicators have the same relative weight in the calculation of α and β .

Next, several scenarios pertaining to regions 1 and 2 and the outcome of the just footprint calculation under *ceteris paribus* conditions are discussed to demonstrate the behaviour of the accounting model.

- *Scenario 1:* Region 1 implements cleaner technologies and therefore reduces the indicator for greenhouse gas emissions intensity (reflecting a change in producers’ parameters- see Table 3).

- A decrease in GHG emissions intensity will lead to an increase in β . As a result, fewer of the emissions associated with exports will be allocated to region 1. This effect, in combination with the decrease in domestic emissions, leads to a decreased ‘just’ footprint.
- *Scenario 2:* Region 1 has more capital available for investment, represented by gross fixed capital formation as a percentage of GDP, and could, therefore, invest in technologies to produce with lower environmental impacts (reflecting a change in producers’ parameters- see Table 3).
 - An increase in this indicator will decrease β and as a result, the ‘just’ footprint of region 1 will increase as more of the emissions embodied in exports are allocated to the region.
- *Scenario 3:* Region 2 opens up to trade and increases the affluence of their citizens as reflected by increased purchasing power parity (reflecting a change in consumers’ parameters- see Table 3).
 - An increase in these two indicators will lead to an increase in β resulting in an increase in the ‘just’ footprint of region 2 as more of the emissions embodied in imports are allocated to the region.

The above-illustrated scenarios exemplify that the calculation of weights behaves correctly in re-allocating emissions for the ‘just’ footprint. It is important to note that the above-described model allows for the inclusion of more indicators than the ones described in Table 4. Establishing a final set of indicators is not the purpose of this article since the aim here is to show a generic theoretical framework. The choice of the indicators can and should be done by relevant stakeholders, such as the United Nations, affected communities or countries, in an inclusive and democratic process.

Since the proposed model is based on MRIO tables, like ‘classical’ footprints, it has the same general weaknesses and strengths (Galli et al. 2012). However, the integration of justice parameters (α and β) in the calculation of the ‘just’ footprints strengthens the acknowledgement by scientists, economists and engineers that eco-socio-economic systems are regulated and operate in a larger scale, which cannot be reduced to economic parameters (e.g. environmental awareness). Such recognition creates a stronger basis for the acceptance of the footprint results. As mentioned before, the suggested parameters are not intended to express all relevant justice issues associated with environmental responsibility but rather demonstrate that is possible to account for at least some justice elements.

The suggested accounting method has straightforward and intuitive premises, which are easily identifiable by public opinion. In turn, this makes the results easier to integrate into policymaking; by articulating economic and environmental data with ethical premises, this model bridges distinct knowledge areas and values that are paramount to sustainable development as, for example, defined by the United Nations (Vasconcellos Oliveira 2018). A sustainable society demands integrated solutions from scientists, economists and engineers, and this model is a small contribution to this holistic perspective.

Discussion and Conclusions

This article argues that environmental indicators, especially footprints, influence the way human impact on the environment is perceived. Footprints shape the opinions and actions of environmental scientists, policymakers, media and the general public. Despite this influence, scientists and engineers still struggle to deliver a desired integrative accounting system.

Environmental policies and environmental justice debates are not immune to the influence of footprints, especially when strategies need to be put in place to mitigate environmental impacts. Two cornerstones of effective policies are (1) knowing who originates the environmental problems and (2) to what extent they can shift towards lower impacts. Despite being easily understandable, and therefore communicated to and by policymakers, footprints so far do not live up to the previously mentioned expectations.

The footprint's dichotomic perspective on each agent's environmental responsibility is insufficient and potentially harmful for policy purposes. The producer and consumer-based methods footprints give an insufficiently accurate picture of reality, distorting the environmental justice debate. Inequality in water use or (inter)national accountability for sharing burdens of carbon emissions are examples of environmental justice topics that need a nuanced description of the phenomena. As Steininger et al. (2014) write, neither consumption-based nor production-based policies have improved climate change. Nevertheless, despite the limitations of consumption-based and production-based footprints, it is not likely or desirable to ignore information originated by footprints, especially when it concerns the variation and destination of environmental fluxes (e.g. pollutants) and resource use, and of environmental impacts.

In the last years, there has been a methodological stagnation in footprint calculation. Still, there is a real possibility to improve the weak points of footprints and re-configure them correctly and efficiently to support environmental policies and also to contribute theoretically and practically to environmental justice. Regardless, it is necessary that the footprint method be a sound one. The policy legitimacy to use footprint results is dependent on footprints that are scientifically accurate and just. Consequently, there is a moral imperative to develop methods that guarantee these attributes.

The proposed 'just' footprint is a methodological framework that attempts to conjugate the most 'just' scientific accounting process (shared producer–consumer method) with elements that concern agency, developmental, distributive and global justice. It is important to make clear these elements do not try to cover all relevant dimensions and issues concerning each type of justice. For example, power distribution among agents, or the effect of carbon emissions or misuse of water or land in worst-off groups are relevant matters for distributive and global justice that are not covered here. Due to the nature of the data available for this footprint and also the way it is calculated, only a few parameters were incorporated. The inclusion of justice parameters in the proposed footprint framework focuses on and contextualises the responsibility of both producers and consumers

for their actions while setting in stone a detailed perspective of environmental agency and responsibility.

In general terms, the 'just' footprint is 'sensitive' to opportunities for environmental improvement. When companies and institutions of a particular region have power (economic capacity) and the means (technology) to produce 'greener' they are more accountable for their impacts. The same reasoning holds for individuals who have and know about 'greener' alternatives and have the economic capacity to buy them. Distinct from other accounting methods, the described 'just' footprint discloses its justice assumptions. Consequently, the agents (scientists, engineers, politicians) who choose to use this method become responsible for pushing forward an environmental accountability perspective based on individual and institutional capacity for (green) shift. Additionally, they turn into conscious agents of an environmental narrative centred on justice for people and the environment. The 'just' footprint is an example of the necessary integration of scientific disciplines to overcome the multifaceted challenges of sustainability. Furthermore, it reinforces a trend in science and engineering of creating knowledge and implementing solutions that meet societal needs (justice) and accommodate moral differences. By drawing on manifest justice premises (variables), the proposed footprint can be adjusted to the ethical evolution of the justice theories themselves. This translates into a lessening of bias and an increase in science transparency.

The (re-)design of a well-accepted environmental assessment tool to meet minimal justice standards thus creates a unique chance of reinforcing policymaking based on scientific and moral foundations. The 'just' footprint shows which variables policymakers can influence for positive environmental and justice improvement. When countries and regions stimulate investment in 'green' technology and facilitate access to it, producers (e.g. companies) have the opportunity to decrease the footprint of the region by installing 'greener' technologies. When countries and regions increase citizens' accessibility (economic and material) to 'greener' products and services and invest in environmental education and awareness, consumers assume a higher responsibility for their impacts.

The 'just' footprint also contributes to a successful environmental strategy in several ways: it facilitates and expedites the use of scientific information, it sanctions the agents involved in the process, and above all, it legitimises the political process and its outcomes. Policymaking procedures, especially the democratic ones, frequently suffer from validity and authority shortcomings undermining their efficiency (Papadopoulos 2013). The situation is particularly acute in environmental issues since the high degree of complexity and numerous trade-offs create extra barriers to a successful implementation of strategies. It is imperative to reconnect the objects of policymaking (citizens, institutions, nations) to the agents who produce legislation. Justice is a universal value that can help in this task. The creation of more 'just' policymaking tools increase the chances for generalised acceptance of measures, even if they might require additional effort from societal agents.

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Paper V

Justice with a future: Contributions from sustainability to Intergenerational Sufficiencyarianism

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Abstract

In 1987, the Brundtland Commission urged nations to conduct sustainable socio-economic development, i.e. to improve present conditions without compromising the ability of future generations to meet their own needs. Against the background of this appeal for sustainable development, there is a call for intergenerational justice, under a sufficientarian framework.

Despite their strong relation, intergenerational sufficientarianism and sustainability developed their core principles somehow apart. We claim that, to some degree, intergenerational sufficientarianism disregards relevant sustainability notions. This neglect undermines the consideration of intergenerational sufficientarianism in the context of sustainability, here operationalised as sustainable development. In response to this insufficiency, we propose the concept of irreplaceable goods as a necessary bridge between the two frameworks. Simultaneously, we stress the need for sustainability scholars to review their claims on unique paths towards resource justice by considering sufficientarianism as a valid alternative to egalitarianism.

To harmonise intergenerational sufficientarianism and sustainability, we firstly delineate sustainability theoretical notions that influence fair distributive futures. Secondly, we incorporate those sustainability constraints in the conceptual background of intergenerational sufficientarianism, in the attempt to articulate them. Finally, we develop the concept of irreplaceable goods as a pivot/anchor for further theoretical development on the minimum needs and conditions for future generations.

Keywords

Irreplaceable goods- Intergenerational justice- Intergenerational Sufficiencyarianism- Sustainable development- Planetary boundaries

Introduction

Justice towards future generations (FGs) is a term commonly used to characterise what is fair to leave to non-contemporaries, along with how political decisions taken today will affect the generations to come. Reflecting about moral permissibility towards future people does not implicate the consideration of specific physical constraints. However, the integration of ecological, sociological, or economic principles in the intergenerational justice framework benefits its theoretical development and applicability to present developmental action.

Fairness towards FGs relates directly to the current societal attempt to act and develop under a paradigm of sustainability. Sustainability itself has a moral essence concerning justice, which was stated by the World Commission on Environment and Development in 1987. Their final declaration pointed to the intergenerational obligations of present people to conduct a ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development, & Brundtland, 1987, p. 41). With time, the international consensus on the SD path (as exemplified by the UN Sustainable Development Goals) evolved to no longer aim for guaranteeing the needs for future people, but rather for making sure that they will have the same conditions as present generations do (Holden, Linnerud, & Banister, 2017).

Departing from this divergence, we problematise the necessary relation between what can be considered fair to leave to FGs and the type of eco-socio-economic development society chooses or should choose to take. We assume what Zuber (2016, p. 66) calls the second approach to intergenerational sustainability, in the sense of focusing on ‘the consequences of current generations’ actions on the opportunities of future ones’, and address the question of whether we have the necessary conceptual tools to devise what is fair for FGs under the assumption of sustainability.

Using Sterling’s and Diesendorf’s formulations of sustainability and SD (Sterling, 2001; Diesendorf, 2000) as a basis for our own, we define these concepts as follows: there is a desired societal dynamic equilibrium state (sustainability) that can be achieved through a path of actions that can be roughly described as sustainable development. We further add that there is no genuine possibility of creating even a minimal state of future well-being, and theoretically legitimising it, if we do not integrate core principles of sustainability in the justice equation. In reverse, the

conceptual development needs clearly to address justice claims, not only from present, but also of future people, in order to be coherent with the inherent time dimension of sustainability.

In the case of this article, we take a sufficientarian view of the justice pattern for intergenerational justice (Page, 2007a). The substantive perspective of intergenerational sufficientarianism comprises sustainability, environmental, economic, and social capitals, i.e. we consider that what should be passed on to future people falls into one of these three categories¹.

The primary goal of this article is to propose sufficientarianism as a reliable alternative to egalitarianism with respect to intergenerational justice. We want to contribute to the intergenerational fairness debate by using the Earth's physical limits concept as a starting point in challenging particular principles of intergenerational sufficientarianism. Additionally, we aim at providing further justifications, directly targeted at sustainable development scholars, about intergenerational sufficientarianism as a valid alternative to egalitarianism when conceiving fair futures. We advocate intergenerational sufficientarianism aligned with strong sustainability. Moreover, we support a vision of strong sustainability that goes beyond the environmental capital (Earth's physical limits) and extends to some social goods.

For a satisfactory adjustment of sufficientarianism to the premises of strong sustainability, we consider it necessary to introduce the concept of irreplaceable goods. This concept helps to single out the crucial resources and services for FGs' (minimal) well-being.

The organisation of the paper is as follows: after the introduction, we describe a few sustainability principles we consider relevant to addressing intergenerational sufficientarian claims. Following this, we enunciate general sufficientarian principles that need consideration under the paradigm of sustainability. The central discussion about the new characteristics of sustainable sufficientarianism is held afterwards. The last section is devoted to conclusions and suggestions for further development of sustainable intergenerational sufficientarianism.

¹ Independently of the specific characteristics of each good, it can be classified as being either an environmental good (e.g. water), a social good (e.g. peace) or an economic good (e.g. commodities).

Sustainability core principles: In theory and practice

In this section, we briefly describe the general characteristics of sustainability, as sustainable development, which influence the debate on intergenerational justice. Mostly, we focus on what should be left to FGs and the conditions for that to happen.

Sustainability as goal: The pathway of sustainable development

The multiplicity of particular significances of sustainability in the context of the FG justice debate requires the establishment of some fundamental characteristics of this concept. As Christen and Schmidt (2012, pp. 400-410) write, the question ‘What is to be sustained?’ seems of particular relevance in connection with fairness and legitimacy. For reasons of simplification and adequacy to the aims of the paper, we adopt a three-dimensional approach to the sustainability capitals² (Lozano, 2008). Our stance is the following: the capitals that are included in any sustainability model are characterised by being ecological (natural resources, sinks, and processes), economic (manufactured and financial capital) or social (human and social capital)³.

Sustainability sciences devote relevant work to establishing the current and future state of potential goods that constitute the sustainability capitals. A recurrent theme in sustainability literature concerns the evaluation of natural resources (Bertram & Graedel, 2006), economic assets (Arrow et al., 1995; Kotlikoff, 1992) and social goods (Rangel, 2003). In many cases, the analysis of such resources or goods is justified by the tacit supposition that future populations will need them.

Examining sustainability capitals’ characteristics (Noël & O’Connor, 1998) makes clear the areas where they do not overlap in their potential to enable human well-being or capabilities. The impossibility of replacing of some goods by others of a different kind compels us to defend a strong sustainability paradigm⁴. Accordingly, we rely on the notion that present and future human

² The term capital means here aggregations of goods and/or services. They can be either flows or stocks, both of them necessary for the functioning of the eco-socio-sphere.

³ We do not endorse any particular model of sustainability (e.g. ‘three pillars’ sustainability model, 3-nested-dependencies model, 3-overlapping circles model, UNESCO four dimensions model, five dimensions model).

⁴ In opposition to this perspective, weak sustainability defends the possibility of human capital to substitute totally the natural capital. For characterisations of strong and weak sustainability, see Neumayer, E. (2003).

well-being cannot be reached by a complete substitution of particular capitals by others of different nature (Ekins, 2003; Neumayer, 2012)⁵. Looking closer at the natural capital, we claim that despite future technological progression, it is impossible to overcome certain limits of the biosphere, i.e. some of the existing stocks and flows from natural capital cannot be duplicated by manufactured capital. As an example, it is possible, with substantial financial investment and enhanced technologies, to mimic some natural plant reproduction steps. However, (insect) pollination cannot be entirely replaced by human-made strategies (Kim & Weaver, 1994). Besides substantial scientific evidence to support our position (Holland, 1997; Huesemann, 2003), there are also ethical (justice) arguments for strong sustainability. As Ott (2003) points out in his second argument for strong sustainability, the people who choose to live by the ‘green virtues’ should have the conditions to do so, and not be forced to relinquish natural capital. In alignment with his position, we argue that, for example, monetary currency cannot represent or fully replace the value of landscapes (Jackson, 2006), animals and plants for indigenous people (Inoue, 2018).

Despite our strong view on sustainability, we do not repudiate some degree of substitution. Rather, we do not accept total interchangeability of capitals. This stance translates into the argument that an intergenerational justice framework that considers full replacement of capitals is not adequate to concede justice to FGs. We stress that the irreversibility caused by depletion and destruction of certain goods above particular levels compromises FGs at a sufficiency level. E.g. a severe loss of insect biodiversity compromises ecosystem services and food security by decreasing crop yield.

We do not believe it necessary to provide a concrete description of what goods should be left for FGs to support our arguments of non- total substitution. We reason that whatever type of stocks and capitals are being passed on, the transmission should occur under the paradigm of strong sustainability so as to guarantee the continuity of, at least, a minimum quality of life.

From non-total interchangeability of sustainability capitals arises a second relevant question: ‘How to sustain future well-being?’ This interrogation leads to an examination of what

Weak Versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms. Northampton: Edward Elgar Publishing.

⁵ Weak sustainability assumes that natural and manufactured capitals are essentially intersubstitutable. Weak sustainability considers the non-existence of essential differences between the kinds of well-being they generate.

exactly SD is. We define SD as a socio-developmental process towards sustainability, i.e. a ‘dialogue of values’ (Blewitt, 2014, p. 6) with the ultimate aim of improved (human) well-being. Earth’s systemic limitations – popularly referred to as planetary boundaries - physically constrain SD. We refer here to planetary boundaries as evolving safe operating spaces for human action (Rockström et al., 2009). The incorporation of this concept in the SD discourse converts the approach to environmental capitals to an ‘absolute environmental sustainability’ (Clift et al., 2017, p. 279). Consequently, we affirm that the intergenerational justice debate cannot bypass the full acknowledgement of Earth’s physical boundaries without becoming weaker.

Another cross-cutting question for both intergenerational justice and sustainability is ‘What is sustainably fair?’ i.e. how should goods be allocated among generations respecting the principles of sustainability? In this case, the two traditions have strikingly different visions. In the philosophical arena, the diversity of theoretical frameworks for approaching justice is evident (Meyer & Roser, 2009), but the same does not happen in sustainability and SD areas.

When scientists envisage and justify SD, they mostly resort to concepts of justice and equity based on welfarism and equalitarianism (Fitzpatrick, 2001; Wilkinson, Pickett & De Vogli, 2010). Publications of reference tend to present a monolithic outlook on the subject. Authors tend to regard the wellbeing of FG in terms of resources and stocks (Agyeman, 2005, 2008; Pearce, 1988), not for example, in experiences or capacities, which we believe to be counterproductive and misleading. We endorse authors like Hopwood, Mellor, and O’Brien (2005) who state that SD has a justice dimension where environmental concerns stem from. However, we disagree with the authors’ position, which subscribes to the obligation of an egalitarian distribution, especially in an intergenerational context. The same hegemonic scenario happens in the political discourse (Fukuda-Parr, 2016; Gupta & Vegelin, 2016). Political discourse indirectly reinforces the predominance of egalitarianism in the SD context, by not clarifying sufficiently to which generations we are trying to concede justice (Vasconcellos Oliveira, 2018). Despite the technical evolution in SD scientific and politic literature, sustainability scientists still believe that if an *intragenerational* equalitarian SD framework is created, justice towards FGs will ensue. Take the example of Holden et al. (2017) or Schroeder and McDermott (2014, p. 31), who claim that the inclusion in SD of equalitarian ‘imperatives’ and Rawlsian justice principles respectively will directly guarantee fairness in FGs.

Our argument for looking outside of equalitarianism for intergenerational justice is further justified by authors like Gosseries (2016), who describes several limitations of this framework. As Piacquadio (2014) mentions for resource distribution, it is not possible to maintain equity between generations in the long term. Furthermore, we evoke as a particular limitation to equalitarianism (under a sustainability paradigm), the fact that human action has already broken some of the safeguard ceilings (Steffen et al., 2015). Some planetary boundaries have already been exceeded⁶ to such a degree that it is impossible to leave an equal amount of resources, services, and conditions for FGs, especially in the long term. The potential (total and substantial) substitution of such resources, services, and conditions by others of a different kind (even if of the same ‘value’), is not likely in many relevant cases, as with insect pollination (Kim & Weaver, 1994).

The ethical and physical limitations to egalitarianism should open the door to the consideration of other justice theories. We argue that sufficientarianism can be a reliable alternative for a fair future (Meyer & Roser, 2009), and therefore politicians and scientists should consider it when reflecting about future scenarios. However, for intergenerational sufficientarianism to be a reliable alternative to intergenerational egalitarianism, it must address the implications of the planetary boundaries.

In the next section, we briefly present and discuss some main features of intergenerational sufficientarianism, in light of sustainability and SD.

What is sufficiently fair for future generations?

We view intergenerational sufficientarianism as a theory of justice that focuses on the well-being of future people in relation to a threshold, and not in connection with the equality among individuals of different generations (Gosseries, 2011; Page, 2007b) i.e. a kind of ‘minimum-satisfaction’ egalitarianism. According to this perspective, it is more important to benefit someone who is below the sufficient level than another who is better off (even if below the threshold). Justice (fairness) is understood here in absolute terms, and concerning the ability to achieve a certain

⁶ The present development has surpassed the planetary boundaries correspondent to biodiversity loss and nitrogen cycle. For more see Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., de Vries, W., de Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B. & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223). doi:10.1126/science.1259855.

previously defined threshold. Strictly speaking, equality is not an adequate measure of justice, as it is necessary to establish a minimum level to guarantee intergenerational fairness.

From a theoretical perspective, sufficientarianism is compatible and combinable with other intergenerational justice perspectives such as egalitarianism (Meyer & Roser, 2009), even in an intergenerational context. In spite of critical differences between sufficientarianism and egalitarianism, sufficientarian criteria are in accordance with some forms of egalitarianism such as up-limit leximin egalitarianism⁷ and the utilitarian aggregative perspective on well-being⁸. Note that both the latter and prioritarian perspectives have a non-individual reasoning. Their objective is set on total welfare. In spite of some degree of conceptual convergence, we will focus mainly on the sufficiency quest as a derivative from *intra*- and *inter*generational sufficientarianism.

Refocusing now on the characteristics of intergenerational sufficientarianism that will differ from the ‘classic’ intergenerational sufficientarianism when sustainability principles are applied, we start by considering ‘inheritance’. What is to be transmitted (capitals and goods) and the fair level of such a distribution forward directly influence the well-being of coming generations⁹.

Intergenerational sufficientarianism, contrary to other justice theories, is non-cleronomic¹⁰. In fact, it does not consider what each generation receives from the previous one to establish the minimum required level for FGs. According to sufficientarianism, present people are not obliged to save and/or accumulate for FGs if future needs can be met up to a sufficient level. Nonetheless,

⁷ The leximin rule dictates that the condition of the worst-off is top priority. The bettering of the worst-off always comes first. In case of ties or as second priority, we should benefit the second worse off. In any case, it is more important to give small benefits to the worst-off than providing large advantages to many slightly better off people who would still have less than average benefits. The up-limit leximin principle creates a ceiling within the worst off. The top priority among the worst off goes to the ones below that threshold (Gosseries, 2011).

⁸ This relates to prioritarian views on welfare. Prioritarianism holds that we serve justice when we maximize a weighted sum of benefit that gives extra weight to obtaining a benefit for a person, the worse off she is prior to receiving the benefit. This implies giving priority to helping the worse off.

⁹ The same reasoning holds for justice criteria like welfare, rights or capabilities.

¹⁰ Cleronomic is a pattern of distribution of goods and burdens that depends on what each generation inherited from the preceding one. For more see Gosseries, A. (2016). *Intergenerational Justice, Sufficiency, and Health*. In C. Fourie & A. Rid (Eds.), *Sufficiency, Justice, and Health-What Is Enough?* (pp. 121-143). New York: Oxford University Press.

the present generation cannot dissipate whatever they desire, because they hold a moral obligation to satisfy FGs' needs up to a minimum rank.

One of the strengths of sufficientarianism, within an intergenerational context, relates to the metrics (Gosseries, 2016). It is reasonable to say that the general necessities of people are rather constant over space and time, even if the resources to accomplish them may vary. Using nutrition as an example, one can expect that future food requirements for a healthy diet will not change dramatically geographically or temporally. We know that different diets meet quality and quantity requirements of present people, albeit situations where some components are not easily available, as in the case of desert populations who trade to obtain foreign salt.

The same constancy holds for 'rights' or 'capabilities' sufficientarianism, as moral and human intrinsic characteristics over time and space are relatively constant. It is equally reasonable to consider that (basic) human rights¹¹, such as religious freedom, have not and will not substantially differ from the ones settled by the UN in 1948. With high certainty, the basic individual capacity of achieving the kind of lives she/he has reason to value is rather constant, even admitting that the means to reach that standard vary considerably¹².

On the subject of demographics, sufficientarianism is sensitive to variations in population size (Gosseries, 2011). This characteristic is particularly relevant in the context of SD because we face constant fluctuations in the number and distribution of planet inhabitants (Lutz, Sanderson & Scherbov, 2001), affecting globally and locally the allocation of resources.

A side aspect to intergenerational sufficientarianism, but relevant in a context of sustainability, is 'savings'. Although the concept of savings in intergenerational justice literature typically relates to the Rawlsian perspective ('principle of just savings') (Rawls, 1978), it has a place in an intergenerational sufficientarian approach too. We consider that there is the possibility

¹¹ Not to be confused with Shue's view on basic rights as foundational for other rights. For more see Shue, H. (1996). *Basic Rights: Subsistence, Affluence, and Us Foreign Policy*. New Jersey: Princeton University Press.

¹² When the justice criterion is 'preferences', the metrics advantage of intergenerational sufficientarianism does not apply, since FG can be influenced by external factors. There is not necessarily a constancy of preferences' profile among generations. For example, formal education and media have the potential to shape the preferences of future populations. In subjects like food or transportation, schools and TV have influenced consumers to choose increasingly more non-meat products and electric vehicles.

(in a single sufficientarian approach) or the necessity (in a Rawlsian and sufficientarian approach) of establishing savings for the present generation when capitals are necessary to meet a sufficient well-being threshold. As discussed in Gaspart and Gosseries (2007), it is plausible, in a consequentialist approach to intergenerational sufficientarianism, to justify restraint from spending even if only during an ‘accumulation’ phase. It is fair to burden present people with setting aside resources when the level of resources is at a stage where they should transfer more to the FGs (Rawlsian principle) to reach a minimum level (sufficientarian principle).

In the next section, we review the characteristics of intergenerational sufficientarianism mentioned previously in an attempt to articulate them with a sustainability perspective. In some cases, we propose new features to the framework so that FGs can attain a continuous state of sufficiency.

Sufficientarianism under a sustainability paradigm

In intergenerational sufficientarianism (and egalitarianism) literature, it is common practice to use abstract currencies of justice for exemplifying theoretical principles (Page, 2007a, 2007b). Nevertheless, some scholars prefer using specific justice currencies like welfare (Meyer & Roser, 2009), rights (Gosseries, 2008), or capabilities (Nielsen & Axelsen, 2017). In principle, we believe this practice to be pedagogically useful. However, we argue that such abstractification disfavours the reflection about how the present socio-ecological conditions, namely the surpassing of the planetary boundaries, affects the core principles of intergenerational sufficientarianism. To help overcome this limitation, we propose an additional concept and the revision of particular characteristics of intergenerational sufficientarianism.

Irreplaceable goods: The foundations of sufficiency

Independently of the substantive nature of the currency of justice, it is plausible to state that well-being¹³ is directly influenced by the quality and quantity of capitals as SD describes them¹⁴. Each type of capital includes different goods (e.g. natural resources, culture, and national savings) that are more or less vital for even a minimum quality of life for any generation. Without going into detail on the concrete type of goods that should be part of an ‘intergenerational sufficientarian

¹³ The same reasoning holds for justice criteria like welfare, rights or capabilities.

¹⁴ We consider three-dimensional sustainability capitals composed by natural, social and economic goods.

basket', it is relevant to establish that some of them are more crucial than others. The criticality of some of these elements – which we define here as irreplaceable goods – is dual: on the one hand, they are foundational to a sufficient (and some even to a minimum) future life condition, and on the other hand, they are significantly affected by present eco-socio-economic development. In other words, there is a sufficient and, in some cases, even minimum condition for future life that irreplaceable goods are essential for. Irreplaceable goods are critical elements for any human being in any generation. They are crucial goods for the pursuit of a future life with at least minimum conditions. Even if future humans could adapt to a world without (some of) them or to a condition where they would be below a certain threshold, they would still be better off with them (above a particular level).

In a canonical formulation, a good is irreplaceable if conditions (1) and (2) are both satisfied:

- (1) The good is absolutely necessary for sufficient life conditions in any given generation;
- (2) The state of the good is influenced by human development.

In some cases, irreplaceable goods cannot, by past, present and/or future actions, be (fully) recovered to desirable levels¹⁵ if they fall below certain thresholds. There are several examples of such goods within the environmental capital. These include biodiversity and freshwater, as they are particularly difficult to recuperate after disruptive human actions. Likewise, several natural irreplaceable goods form interrelated nexuses that support global ecosystems (Cardinale et al., 2012, p. 59; Dudgeon et al., 2006), and are accordingly both essential and susceptible to human activity. In this case, of their absence or if they fall below certain levels, human beings can become extinct.

We would like to add that natural irreplaceable goods are not equivalent to non-renewable resources. In the notion of irreplaceability, we include a low or compromised renewability (e.g. soil quality) (Várallyay, 2007). In that respect, irreplaceable goods are closer to 'critical natural capital' (Ekins, 2003; Ekins et al, 2003). Irreplaceable goods share certain similitudes with these environmental (or natural) critical goods in the sense of being goods that perform important and not substitutional roles, which may include intangible functions (e.g. nature as heritage) and are

¹⁵These natural goods tend to fall in the category of not total substitution.

needed for human well-being (Noël & O'Connor, 1998). Nevertheless, they are a broader category, which extends further than the natural realm. Irreplaceable goods also share similitude to Anderson's (1997) 'incommensurable goods', in the sense of impossibility or great difficulty in value comparison. However, in the case of irreplaceable goods, there are pragmatic reasons to try to compare distinct goods. Biodiversity as an ecosystem service is such an example. Ecosystem services are an attempt to reduce natural goods to a 'monetary', and therefore comparable value (Bateman, Mace, Fezzi, Atkinson & Turner, 2011). This type of quantification makes clear how much society is in debt to natural capital (Schröter et al., 2014). Nevertheless, the commodification of nature reinforces the idea of total substitutability of natural capital, which, as we explained before, is far from true. Irreplaceable goods also have common features with social resources, since these elements may also be resources embedded in social networks and used by individuals for actions (Huber, 2009). However, social irreplaceable goods include only the vital resources for a sufficient life conditions, which is not the case for the social resources, which integrate far more dimensions with some of them being substitutable (e.g. social status, money).

It is indisputable that there are elements which are and will be the substrate of at least a minimum standard of living that we would like to leave to FGs. Since they are part of the non-negotiable items in any possible 'sufficiency intergenerational basket', irreplaceable goods deserve particular attention by sufficientarians. More importantly, and because the type of societal development undoubtedly affects the quantity and quality of such elements, sufficientarian principles are, in practice, dependent on the continued existence of these goods in at least a minimum amount and quality.

The concept of irreplaceable goods is a direct consequence of the adoption of a strong stance on (environmental) sustainability, but extends beyond the sphere of the natural capital. We include in this notion some types of social capitals. We claim that social goods such as human rights, culture, justice or peace are fundamental for sufficient levels of well-being, rights, or capabilities. We believe that such goods cannot and should not be substituted by others of a different kind. Exchanging peace for economic or natural assets does not seem desirable or even possible in a contemporary society. At the moment, we see many cases (Afghanistan, Iraq) where the degradation of social, economic, and natural conditions due to armed conflict is such that even with an immediate truce, it will take many decades to re-establish a healthy environment for the populations. Consequently, we aver that if social irreplaceable goods are eroded to certain levels,

the time and opportunity to recover them might be undesirably long or even inexistent, rendering them precious to both present and FGs. Moreover, material goods cannot be enjoyed without social conditions that enable their healthy use/consumption, e.g. peace, equity, human rights.

Despite the common characteristic of criticality, there is an important distinction between material and social enabling goods as irreplaceable goods: the distribution across generations is ontologically different. Material goods are protected from depletion by regulating use/consumption. Environmental goods such as soil, water, air or cultural patrimony should be protected from destruction or pollution so that they can still be enjoyed by future people and life forms. However, social enabling conditions, unlike these material goods, need to be enhanced by teaching children, for example, new ways of relating, regulating citizens' behaviour to discourage racial discrimination, encouraging protest action to stop racist cultures and ways of relating, etc. These distinct ways of 'distributing' irreplaceable social goods tend to be figurative compared to the more literal consuming less/saving more for the future. Each type of irreplaceable goods calls for a different kind of justice; environmental and social material goods are susceptible to distributive justice and resource allocation, while other social enabling goods are to be acted upon through enacting elements such as civil rights or just politics of recognition.

It is also relevant to make clear that irreplaceable goods are not the only elements necessary to achieve sufficiency for FGs. The example of social acceptance shows that despite being critical to sufficient wellbeing, it might be substituted by social engagement without risking a decrease in overall wellbeing.

In sum and due to the criticality of (all types of) irreplaceable goods for FGs, we believe it to be crucial to demarcate these elements within the sufficientarian theoretic framework. The principles of sufficientarian intergenerational distribution need to reflect the intrinsic characteristics of irreplaceable goods or fail to grant justice to FGs.

In the following sub-section, we revise the intergenerational sufficientarianism criteria, which are affected by SD principles, and by the differentiation of the irreplaceable goods.

The shape of sustainable intergenerational sufficientarianism

Following the strong stance on sustainability and the introduction of the concept of irreplaceable goods, we defend the revision of some intergenerational sufficientarian principles.

Looking again to the subject of inheritance of capitals and goods, we support a moderately cleronomic version of intergenerational sufficientarianism. We consider it necessary to ponder the inherited situation from past generations when establishing sufficientarian distributional claims. The need to open the door to cleronomic considerations derives from a strong sustainability stance and the existence of irreplaceable goods. The justification for this claim is that a minimum sufficientarian threshold, at least for the irreplaceable goods, is bounded by past actions.

On the matter of the potential need for present generations to save goods and capitals to prevent them from falling below the required sufficient threshold, we advocate the duty of refraining from spending certain capitals if sufficiency is in question¹⁶. In the case of the irreplaceable goods, we argue for saving and/or promoting the maintenance of the current level because of the low or impossible substitutability. When capabilities and rights are the sufficientarian justice currency, we find it advisable to extend the savings beyond basic goods as the fulfilment of sufficient capabilities and rights requires more elements than in a basic-needs perspective. For example, access to culture is not considered to be a basic need. However, the enjoyment of cultural goods favours the achievement of full citizenship and enables the individual to achieve a better life. In a scenario where capabilities or rights sufficientarianism is the justice framework, it is a moral duty to save not only basic goods, such as water, but also cultural goods like traditional music.

We comply with the sufficientarian notion of present generations' (possible) over expenditure ('dissavings') to the extent of not endangering future sufficiency¹⁷. Nevertheless, we argue that when a capital level is above sufficiency, it is still possible to justify saving it for FGs on account of a 'precautionary' principle¹⁸. Despite the constancy over time of basic well-being,

¹⁶ This follows the Kantian notion of 'negative duty' in terms of (non-)using the good when its level falls below a threshold. In the case of irreplaceable goods being social-enabling situations, there is a 'positive duty' of creating and fostering those conditions so FGs can enjoy them, at least, in sufficient levels.

¹⁷ For more on the fairness of savings and dissavings, read Gaspart, F., & Gosseries, A. (2007). Are generational savings unjust? *Politics, Philosophy & Economics*, 6(2), 193-217.

¹⁸ We interpret the precautionary principle as mechanism to guarantee higher levels of present and future environmental and human protection through preventative decision-taking in the case of risk. For more on the application of the precautionary principle to FGs debate, see Gardiner, S. M. (2006). Protecting Future Generations: Intergenerational Buck-Passing, Theoretical Ineptitude and a Brief for a Global Core Precautionary Principle. In J. C. Tremmel (Ed.), *Handbook of intergenerational justice* (pp.148-169). Cheltenham: Edward Elgar Publishing.

rights, and/or capabilities, there is an inherent degree of uncertainty regarding future eco-socio-economic scenarios that can serve as justification for not dissipating capitals.

Accounting for this degree of future uncertainty makes us consider investments for FGs desirable but not obligatory, except for the irreplaceable goods. As these elements are either critical for human well-being or (many) currently below a sufficient threshold (e.g. biodiversity, peace), we believe it to be mandatory for present generations to devote time and resources to reverse the current situation and promote future sufficiency, when possible. Since sufficientarianism is demographically sensitive, we should account for potential global or local demographic growth. In a scenario where there are more future people to share limited capitals, especially the irreplaceable goods, the addition of the investment and savings principle as described above adds consistency to intergenerational sufficientarianism.

The integration of the strong sustainability paradigm in intergenerational sufficientarianism also brings (potentially) controversial or counter-intuitive implications. One of them is the (non-) use of goods or resources that have been overshoot in terms of planetary boundaries. Using the example of fresh water use (European Commission, 2015), it would mean that present people, and most likely proximal FGs, could not use this resource, or in more plausible terms, they could only use fresh water in cases of 'extreme' need. Additionally, at the same time, they would have to save the resource as much as possible so next generations could have it at a sufficient level. In such cases, it is easy to see the emergent intergenerational conflicts in the attainment of sufficient wellbeing. The same example also shows how difficult it would be to deal with present and future (e.g. geographical, cultural) inequalities in access and quality of goods when setting minimum thresholds. A similar reasoning holds for the responsibility in saving irreplaceable goods. There are other associated uncertainties connected to the investment of efforts in savings: how and to what extent can/must present generations invest in irreplaceable goods when they are by design difficult or might be impossible to recover when they fall below certain levels. The recovery of fresh water is not the most difficult case since there is already technology for (at least partially) accomplishing this task. Nevertheless, in case of the nitrogen cycle or endangered cultures, we may be far away from knowing how to recover their integrity (if it is possible at all).

In summary the alignment of the intergenerational sufficientarianism theory with sustainability criteria requires more nuanced justice principles and acquiescence to the present eco-

socio-economic landscape. Furthermore, it raises difficult questions and requires of present generations efforts that might be, in some cases, very hard (or even impossible) to make.

Conclusion

Developments in sustainability studies ripple outside the traditional natural and political sciences. In the field of environmental and distributive justice, scholars are trying to make sense of the theoretical implications of these developments in the classical frameworks. This work seeks to clarify some of the effects of the relatively recent sustainability concept of planetary boundaries in the context of the intergenerational justice debate. The idea of limits to human development is not new to either environmental sciences or ethics. However, the consequences for FG justice of such boundaries are yet to be fully developed and understood.

Scenario building is increasingly becoming a preferred tool for sustainability scientists, since it allows them to explore different narratives for SD. In any future scenario, it is central to establish a just distribution of environmental burdens and benefits. So far, sustainability and SD scientists have considered mainly egalitarian distribution principles. We challenge this approach on both ethical and environmental grounds and propose intergenerational sufficientarianism as a valid alternative.

For intergenerational sufficientarianism to be a credible option for granting justice to FGs, it must incorporate the planetary boundaries framework. This would facilitate the generalised acknowledgement of its potential by scientists and politicians.

In this article, we propose adjustments to some core principles of intergenerational sufficientarianism and the distinction of irreplaceable goods. The concept of irreplaceable goods is a direct answer to the acknowledgement of planetary boundaries and the adoption of a strong sustainability paradigm. We consider that low or non-substitutability of certain natural and social goods renders them vital for any fair future scenario. Envisioning a general sufficient, and in some cases even minimum threshold of well-being, rights, or capabilities without considering and specifying irreplaceable goods makes the exercise futile.

The establishment and integration of irreplaceable goods in intergenerational sufficientarianism require other theoretical adjustments. The creation of minimal conditions for FGs entails the consideration of how inherited levels of irreplaceable goods affect the capacity and

moral responsibility of present generations to leave these goods for the future. The existence of irreplaceable goods also makes their savings compulsory for present people, which triggers challenging implications in a concrete implementation scenario.

In summary, the harmonisation of sufficientarianism with SD principles drives both frameworks further. The main advantage of bridging these two knowledge fields comes from an enhanced applicability of fairness principles in practical political contexts. We believe our contribution to be just a small part in the overall effort to build a sustainable and fair tomorrow.

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