Equitable Downscaling to Address the Climate Crisis with a focus on Europe

Policy Brief[1]

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1 Introduction

The climate crisis is one of the defining issues of our time. The actions we take – or not take – now will determine the conditions for life not only for us and our children, but for all life on earth for millennia to come. Cheap energy from fossil fuels has allowed many countries to develop, spurring enormous gains in technology, health, and affluence more generally. But the chickens have come home to roost. Floods, wildfires, extreme heat, and other so-called 'natural' disasters have become frequent and widespread, even at a mere 1.1 °C warming above pre-industrial temperature levels. Currently, the world is on track for a warming of 3 °C by the end of this century (United Nations Environment Programme, 2020).

There is little doubt that a world warmed by 3°C would be utterly catastrophic for civilization, potentially triggering tipping points that might even render Earth uninhabitable (Lenton et al., 2019; Steffen et al., 2018). It is especially in this context that the Paris agreement is of key importance, promising to keep "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels".

The challenge is enormous. Figure 1 illustrates various pathways for achieving the 1.5°C target in the context of historic emissions, using the most recent estimates by the Intergovernmental Report Intergovernmental Panel of Climate Change (IPCC, 2021a). Even if all nations would, from tomorrow onwards, seriously take up action and follow the pathways outlined in the Special Report on 1.5°C (SR15) by the IPCC, we believe that two pernicious issues remain that may put achieving the Paris target into jeopardy.

[1] Most of this document was written during the Exploring Economics Summer Academy 2021 workshop *Political Ecology, Degrowth, and the Green New Deal*. Not everything in it necessarily reflects the opinion of all authors.

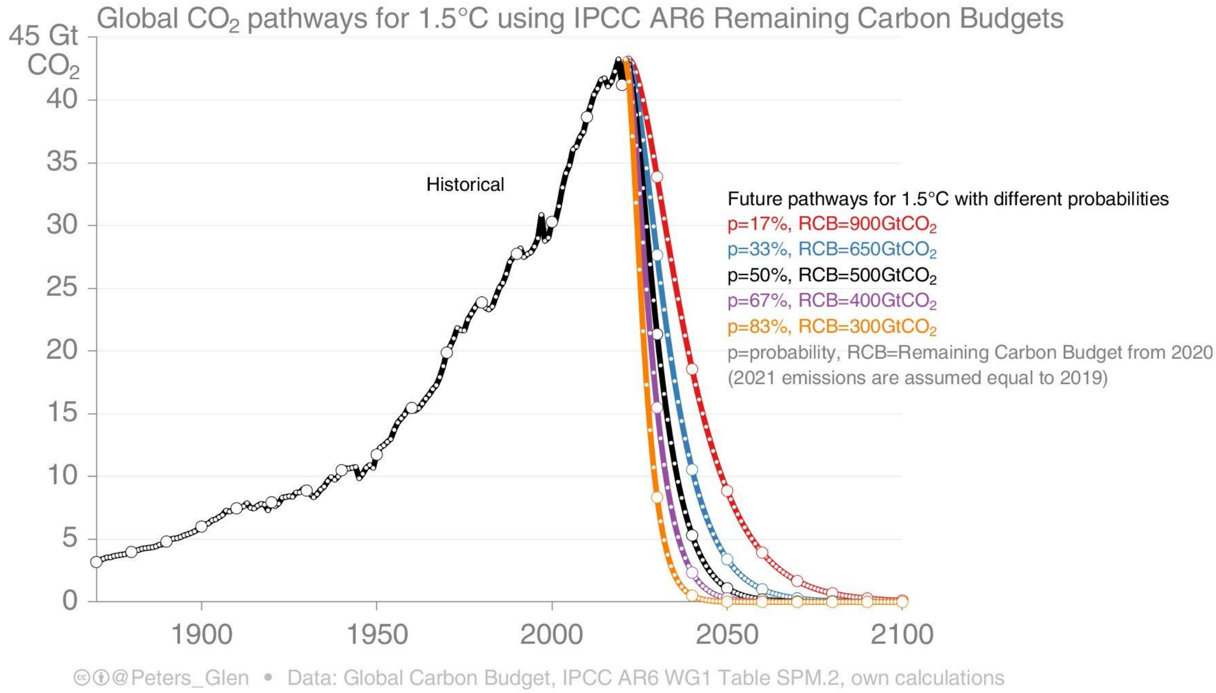

Figure 1. Shows pathways for reaching the 1.5 C target with a particular probability without negative emissions in the context of historical emissions. Taken from Peters (2021).

First, the majority of IPCC scenarios rely on large-scale deployment of negative emissions technologies that will remove CO_2 from the atmosphere in the second half of this century. These technologies, however, are in a very early development stage and unproven at scale (Anderson & Peters, 2016). The most widely proposed method – bioenergy with carbon capture and storage (BECCS) – entails non-trivial trade-offs among competing needs such as food production and land use. A recent report by Oxfam notes that BECCS, afforestation, and reforestation could lead to food insecurity of 250 million people (Sen & Dabi, 2021). Large scale BECCS would also entail further pressure on ecosystems leading to biodiversity loss (Sanchez et al., 2015). In our policy brief, we will follow the precautionary principle and avoid relying on large-scale negative emissions technologies.

Second, the majority of IPCC scenarios assume that a decoupling of aggregate economic growth from emissions is possible at a speed commensurate with reaching the 1.5°C target. In other words, the scenarios assume that the goods and services produced can increase at about 3% per year on aggregate, while the emissions can be reduced to 'net' zero. Indeed, the assumption of such 'green growth' is connected to the assumption of the viability of negative emission technologies, as the latter would allow us to continue growing sectors of the economy that are hard to decarbonize. The rates of decoupling assumed in the IPCC scenarios are historically unprecedented, and empirical evidence is mounting that decoupling is not being, and cannot be, achieved in time to limit warming to 1.5°C (Haberl et al., 2019; Hickel & Kallis, 2019; Parrique et al., 2019; Vadén et al., 2020). As with negative emissions technologies, in this policy brief we will avoid relying on decoupling or 'green' growth (see also Hickel et al., 2021).

Instead, in this policy brief we propose an equitable downscaling of energy use to limit warming to 1.5 °C, focusing on European countries. In Section 2, we motivate a carbon budget for Europe that respects international and intergenerational justice. In Section 3, we summarize the existing carbon and energy inequality among and within European countries. In Section 4, we review the scientific literature developing scenarios that allow a good life for all within planetary boundaries, and summarize the implications for Europe. In Section 5, summarize a number of policy suggestions, and in Section we conclude.

2 A Fair and Just Carbon Budget

Figure 1 makes clear that global emissions have to fall drastically to meet our climate targets. A key concept to quantify how much CO_2 we can still emit to reach these targets is the *carbon budget.* In general, the carbon budget is defined as the total amount of CO_2 emissions that leads to a specific increase in global mean temperature (Alcaraz et al, 2018). Another synonymous term used for the carbon budget is the 'total cumulative net emissions of anthropogenic CO_2 emissions' (Rogelj et al. 2016). According to the IPCC Working Group I (WGI) report AR6, the main driver of long-term warming since pre-industrial times is the total cumulative net emissions of anthropogenic CO_2, which has a near-linear relationship with long-term temperature increase (IPCC, 2021a). If the warming caused is to be limited to or below a certain temperature threshold, CO_2 emissions must therefore be limited accordingly.

Carbon budgets can differ widely depending on the specifics of the methodology and mitigation pathways applied. A key distinction is between *avoidance* budgets, which define the extent of the cumulative emissions allowed to stay within a particular mean global temperature increase by 2100, and *exceedance* budgets which give the cumulative emissions before a particular temperature threshold is crossed (Peters, 2018; Rogelj et al., 2016). In addition, there are uncertainties in the climate system and in the carbon cycle, resulting in uncertainties in the carbon budget (Anderson & Peters 2016). Similarly, the carbon budget depends on the mitigation of other greenhouse gases; for example, increasing methane emissions would naturally decrease the carbon budget. According to the latest report, the IPCC reckons that depending on non-CO_2 emissions the carbon budget shown in Figure 1 can increase or decrease by 220 Gt CO_2 or more (IPCC, 2021b). While there are serious limitations with carbon budgets, we will use them in the remainder of the policy brief as a tool to explore equity and inequality considerations.

Being defined as the total cumulative emissions that are allowed to enter the atmosphere to reach a particular climate target, carbon budgets refer necessarily to the relatively distant future. Here, we use them as a tool to assess the necessary emission cuts in the next decade. Indeed, the 2020s are the defining years to make progress on the climate crisis. In this decade, *global* emissions have to be cut in half to have a chance of limiting warming to 1.5 °C (e.g., Rockström et al., 2017). More specifically, the best estimate for global CO_2 emissions from fossil fuels and industry in 2030 to stay below 1.5 °C is 18 Gt CO_2 per year (IPCC, 2018).[2] Assuming a population of 8.5bn in 2030, the 18 Gt CO_2 would result in global mean per capita CO_2 emissions of about 2.1 tCO_2/year (Gore & Alestig, 2020). This amounts to a reduction for EU countries of more than 75% below 1990 levels. Importantly, this emissions target does not account for the historical emissions that global North countries such as the EU-27 have enjoyed.

However, it is not only important that Europe transitions away from a carbon-dependent growth economy in order to stay within planetary boundaries, but also that it does so in a just way. Therefore, how much of the remaining global carbon budget can be allocated to Europe has to be subject to a range of equity considerations. Such equity considerations are deeply rooted into international climate cooperation with article 3.1. of the United Nations Framework Convention on Climate Change (UNFCCC) enshrining the principle that "the Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities". This principle is also reaffirmed in the Paris climate agreement. Mattoo and Subramanian (2012) suggest several *principles of equity* to determine carbon budget allocations such as (1) the equal right of all the world's inhabitants to the global public good of a clean atmosphere, (2) the differing historical responsibilities of countries for causing emissions, (3) their ability to pay for the costs of climate change mitigation strategies, and (4) their right to development.

The first criterion simply implies that the starting point of all carbon budget allocations should be an equal allocation of per capita emissions among countries, which can then be adjusted to take into account one or more of the equity principles outlined above (Mattoo & Subramanian, 2012; Alcaraz et al., 2018). One such principle would be the intergenerational corrective justice criterion of historical responsibility, which suggests that countries who have exceeded their fair-share of the cumulative global carbon budget within the planetary boundary of 350ppm (Steffen et al., 2015) should be allocated a smaller share of the remaining global carbon budget to compensate for their overuse in the past (Alcaraz et al., 2018; Mattoo & Subramanian, 2012; McKinnon, 2015). Essentially, the historical responsibility principle incorporates both the approaches of 'polluter pays' and 'beneficiary pays' in regards to historical emissions. In other words, those countries that have contributed the most cumulative emissions have also benefited from these high emissions in the form of accelerated economic development and should therefore bear a higher share of the costs to solve the problems caused by those past emissions (McKinnon, 2015). Indeed, Hickel (2020) shows that it is the wealthy developed countries of the Global North, led by the US, Russia and Europe, that have massively overshot their fair share of a sustainable global emissions budget and thus owe a 'climate debt' to developing countries, such as India, that used up less than their fair share. This unequal distribution of historical responsibility across the world is illustrated in Figure 2.

[2] We use this estimate from SR15 to be in line with work by Oxfam which we discuss in Section 2. Figure 1 shows that emissions would be around 21 Gt CO_2 for a 50% chance to limit warming to 1.5 °C (with higher chances resulting in more drastic cuts).

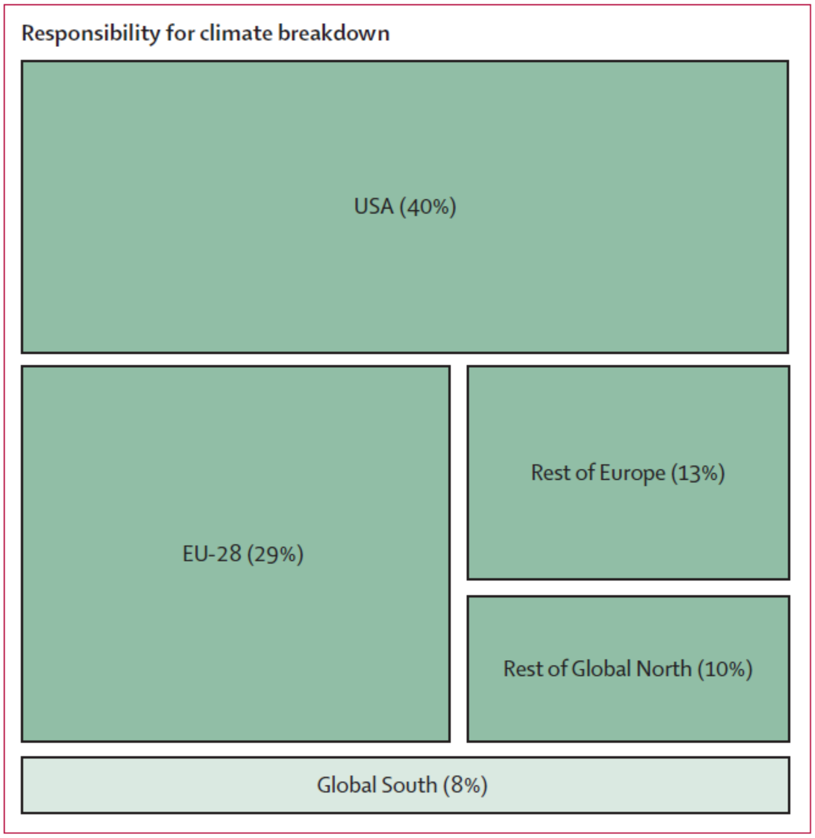

Figure 2. Shows how much Global North countries and regions have exceeded their fair share of an ecologically-sustainable global emissions budget. Taken from Hickel (2020).

However, the exact date from which climate debtor countries can be held responsible for their historical emissions is still a matter of debate. The debate is centred around the question of whether countries should be held liable for the damage caused by their emissions at a time when they could not be reasonably expected to be aware of the harm those would cause (Alcaraz et al., 2018; Mattoo & Subramanian, 2012). Those who believe that knowing one is causing damage is paramount for liability incorporate historical responsibility into the carbon budget starting from either the 1970s, when the United Nations Environment Program was created, or from the 1990s, when the establishment of the UNFCCC made the problem of climate change apparent to all (Alcaraz et al., 2018). Others, in line with the 'beneficiary pays' principle, argue that since the development of Global North countries was made possible by emitting carbon into the atmosphere, they should be held responsible for their emissions starting from the industrial revolution (see Alcaraz et al., 2018). An advantage of the link between historical responsibility and economic development is that by applying the historical responsibility principle to the carbon budget allocation, one also implicitly incorporates the equity considerations outlined above in equity principle (3) ability to pay and (4) right to development into the equation since those countries with the highest historical responsibility are also the ones with the high level of development needed to more easily cope with a drastically reduced carbon budget (Alcaraz et al., 2018). Therefore, it is in the interest of intergenerational distributive and international justice that Europe, and particularly the EU-27, accept a greater responsibility to reduce carbon emissions by operating within a carbon budget that is reduced by their historical emissions responsibility during the green transition period. From this perspective, it becomes clear that the global target of reducing CO_2 emissions to 18 Gt per year by 2030 should not be distributed equally across the globe (which would result in 2.1 tCO_2/year per capita for Europeans), but that Global North countries should get a much smaller cut than Global South countries. Indeed, if one follows Hickel (2020), who argues that Global North countries are already in emissions overshoot, then Global North countries should reach zero emissions as soon as possible, since their remaining carbon budget would be zero. The challenge of reducing emissions in Europe to 2.1 tCO_2/year by 2030 is already enormous, however, and in the next section we will use this number as a baseline to explore the stark carbon inequalities that exist in Europe.

3 Carbon Inequality in Europe

While European countries are in cumulative emissions overshoot, not all Europeans are equally responsible for this state of affairs. Moving from intergenerational and international to intersectional justice, we find extreme carbon inequality within Europe: the bottom 50% of EU households in terms of carbon footprints consume about 4 tCO_2eq per capita, while the top 1% of EU households consume 54.9 tCO_2eq per capita (Ivanova & Wood, 2020), as visualised in Figure 3.

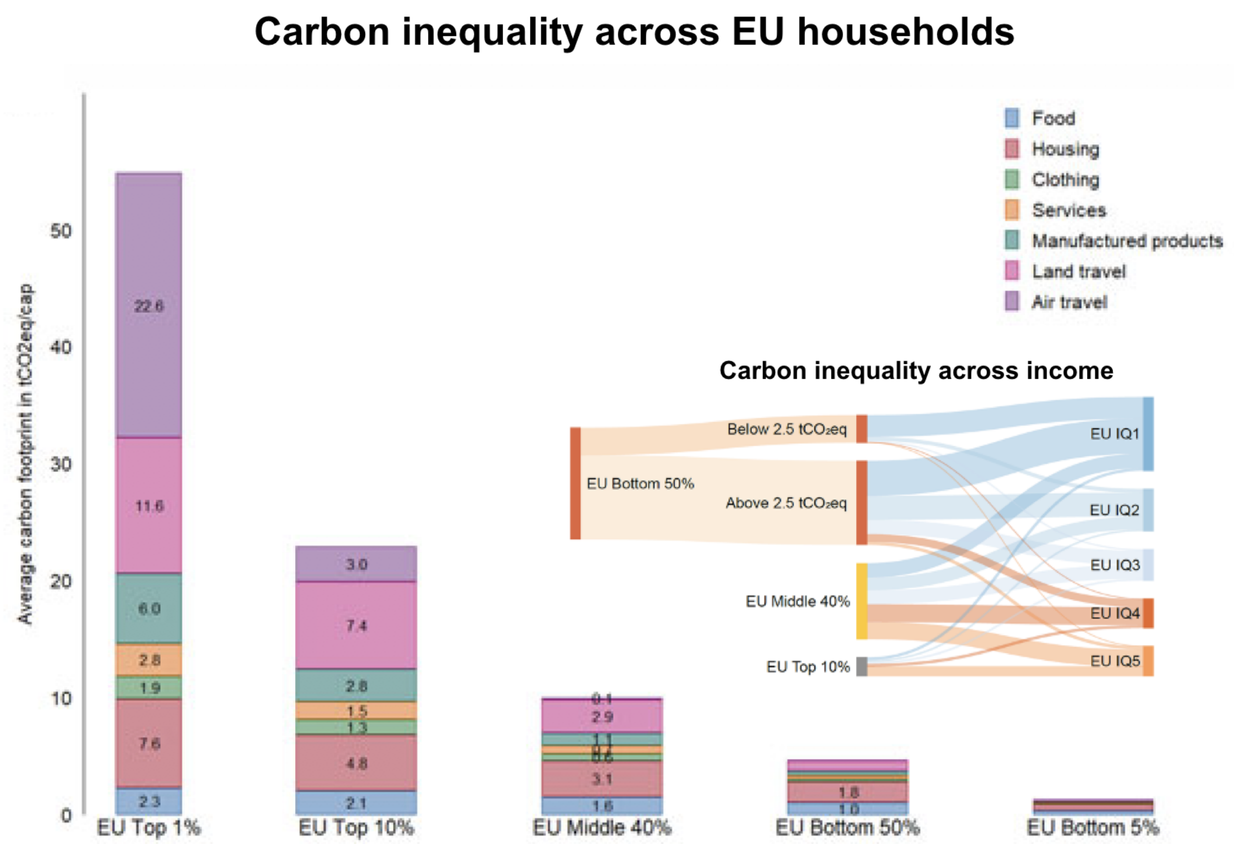

Figure 3. Shows average carbon footprint in tCO_2eq per capita across EU households by consumption category. The average household size of the Top 10%, Middle 40%, and Bottom 50% are 1.7, 2.1, and 2.6, respectively. Top 1% refers to the 1% of households with the highest carbon footprint. Inset figure shows the relation between carbon consumption and income quintiles. Adapted from Ivanova & Wood (2020).

Figure 3 shows that the most unequal consumption category is mobility, especially air travel. Air travel is both a luxury good and of high energy intensity, suggesting that, unsurprisingly, rich people have a larger carbon footprint than poor people (Oswald, Owen, & Steinberger, 2020). Indeed, Ivanova & Wood (2020) find that households with the highest carbon footprint are by and large the households with the highest level of income, as the inset figure in Figure 3 illustrates. The authors note that the strong correlation between income and carbon footprint holds across EU member states, and researchers have recently begun to focus on the climate contributions of the super-rich (e.g., Otto et al., 2019) and affluence more generally, with Wiedmann et al. (2020) noting that “[...] a significant proportionality between consumption and impact exists for a large range of environmental, resource and social indicators”. In a similar spirit, a recent Oxfam report calculated the carbon footprint across income groups for EU member states, showing vast disparities both between as well as within countries (Gore & Alestig, 2020). Specifically, while the majority of emissions caused by the richest 10% are from citizens of richer EU member states and the majority of emissions caused by the poorest 50% are from citizens of poorer EU member states, Figure 4 shows that the richest 1% in each country lead lifestyles that, on average, lead to about 30 times more emissions than the 2.1 tCO_2

per capita allocated by 2030 to stay within 1.5 °C, with the rich in Luxembourg being off the charts. The richest 10% overshoot by a factor of 10. In contrast, the footprint of the poorest 50% need only to be about halved by 2030. Importantly, carbon intensity tends to *decrease* with increasing affluence because of access to cleaner technologies for heating and electricity (Jaccard et al., 2021). This implies an even stronger imbalance in responsibility between the rich and the poor, with increases in energy efficiency potentially going a long way to reduce the carbon footprint of the (for European standards) poor.

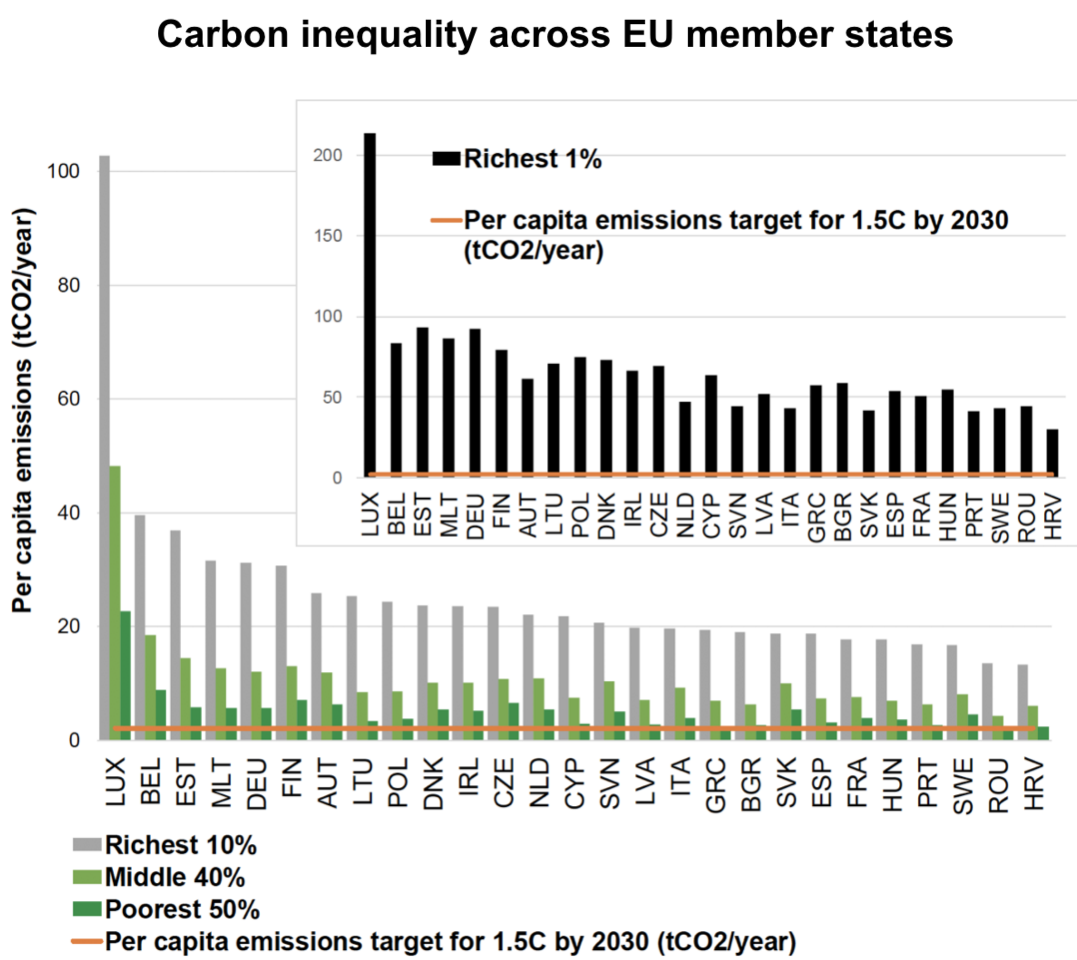

Figure 4. Shows average carbon footprint in tCO_2 per capita across income groups across all EU member states, together with the 2.1 tCO_2 per capita emissions target for 2030 in line with a 1.5 °C pathway (solid orange line). Taken from Gore & Alestig (2020).

With CO_2 emissions from the burning of fossil fuels and industrial processes, that is energy-related activities, being responsible for about two thirds of greenhouse gas emissions (IPCC, 2014), it is not surprising that there exist stark inequalities in energy use. In European households, final energy footprints range from less than 50 GJ per capita to over 200 GJ per capita (Oswald, et al., 2020; Jaccard et al., 2021). In recent years, researchers have put forward scenarios that show how an equitable distribution of energy consumption can limit temperature increase to 1.5 °C while providing a good life for all (e.g., Grubler et al., 2018; Oswald et al., 2021; Millward-Hopkins et al., 2020; Jaccard et al., 2021). These researchers sketch out pathways that allow nations to fulfill key social (i.e., well-being) indicators without overshooting planetary boundaries, a feat no country currently achieves (O'Neill et al., 2018; Raworth, 2017). In the remainder of this policy brief, we will focus on these scenarios with a special emphasis on Europe.

4 Fostering Well-being within an Equitable Energy Allowance

As discussed in the introduction, we avoid relying on negative emission technologies and on green growth in this policy brief because the empirical evidence argues against them being feasible approaches to reach the Paris target. Instead, the most feasible option is to foster lifestyle changes that bring about a reduction in energy consumption to allow for the required shift from fossil fuel-based energy to renewable energy within the carbon budget. A decrease in energy consumption would also have the added benefit of relieving pressure from the environment by reducing material extraction and the waste generated at the end of the technologies and products' life cycle. A decrease in energy consumption further implies that the economy experiences lower and, eventually, negative growth rates, something that is usually associated with the detrimental outcomes of recessions. In our policy recommendations (Section 5), we discuss how to avoid such negative consequences while fostering societal well-being.

Well-being and prosperity have been shown to be de-linked from GDP growth. While well-being does increase up to an income level that allows for satisfying basic needs, after such a level is reached, a higher income is not a proxy for higher well-being (Easterlin, 1974; Fanning & O'Neill, 2019; Steinberger et al., 2020). Moreover, higher GDP does not necessarily imply lower inequality. If the increase in GDP does not benefit the lower and/or middle-income classes, GDP growth entails only higher inequality. Therefore, we need to look beyond (GDP) growth-focused policies to promote equitable societies that increase well-being for all (see also Barmes & Boait, 2020). Note that going beyond GDP growth, that is decoupling well-being and prosperity from GDP, also decreases our impact on ecosystems since higher GDP implies a higher natural resource use (i.e., material and water consumption; Parrique et al., 2019; Haberl et al., 2020; Wiedmann et al., 2015).

The only SR15 IPCC scenario that is able to stay within the 1.5°C target without relying on negative emission technologies, the *Low Energy Demand* (LED) scenario, implies drastic lifestyle changes (Grubler et al., 2018; Allen et al., 2019).[3] Recently, Millward-Hopkins et al. (2020) developed another low energy demand scenario in line with the 1.5°C target, which they called the *Decent Living Energy* (DLE) scenario. While we describe these two scenarios in more detail below, it is important to note that these two scenarios imply radically different futures compared

[3] Note that we do not classify nature-based solutions as a negative emissions technology. The LED does assume the use of nature-based solutions to remove carbon from the atmosphere.

to those prescribed by all the other scenarios used in integrated assessment models that rely heavily on negative emission technologies (Allen et al., 2019; Keyßer & Lenzen, 2021). One stark difference between DLE and LED concerns GDP growth, which in turn implies radically different policy prescriptions to achieve the Paris target. One commonality is that neither of the two scenarios (LED and DLE) by themselves can ensure economic and environmental justice and that well-being is equitably distributed within and across countries. Instead, to ensure these desirable outcomes are attained appropriate policies need to be put in place, which we discuss in Section 5.

To ensure the transition to net-zero emissions fosters societal well-being while downscaling energy consumption, it needs to be a just transition based on providing universal decent living standards. Rao and Min (2018) develop a framework of Decent Living Standard (DLS) that defines material requirements essential for human flourishing. These include ensuring everyone's material satisfaction of nutrition, shelter and other living necessities, hygiene, clothing, healthcare, education, communication and information, and mobility. Millward-Hopkins et al. (2020) build on the DLS framework by giving it quantitative grounding and embedding it in a global energy model. In their DLE scenario, global final energy consumption reaches 149 EJ or an average of 15.3 GJ/cap/yr (13-18.4GJ/cap/yr) in 2050 (similar to average global consumption in 1960s). Note that 1 GJ is about 278 kWh, and so 15.3 GJ are 4250 kWh. As a comparison, Oswald et al. (2020) report that energy use in Europe currently ranges between 50 and 200 GJ/cap/yr. The DLE scenario is more than 60% lower than current global energy consumption (despite assuming a rise in population), 60% lower than the International Energy Agency's (IEA) most ambitious Sustainable Development scenario's 2050 estimate of just under 400 EJ, and 40% lower than the 245 EJ (20-50GJ/cap/yr) LED scenario of Grubler et al. (2018).

The DLE scenario's highly ambitious 15.3 GJ/cap/yr estimate relies on the deployment of advanced technologies and radically lower demand. For example, they assume all houses would be built anew with the best low-energy technologies, that all citizens have access to free public transport, that people embrace diets that are low in animal products consumption and major technological transfer programmes to the Global South (for other, less ambitious scenarios, see Millward-Hopkins et al., 2020).

Jaccard et al. (2021) focus on Europe and study the energy and carbon inequality that is consistent with a 1.5°C target. Using data from 2015, they find that the top decile (by expenditure) uses about 3.9 times more final energy than the bottom decile, and that this ratio would increase to 7.3 if the poor would have access to the same energy efficiency as the rich. Importantly, the authors find that, if one does not assume speculative negative emissions technology, a higher minimum final energy use naturally requires a more strongly reduced energy inequality. The DLE scenario discussed above assumes a very equitable energy use across the globe, which is difficult to achieve politically. Jaccard et al. (2021) show, however, that there are hard bounds on energy inequality if we wish to reach our climate goals. This stresses the enormous importance of reducing energy inequality.

These findings give a clear picture of how energy consumption could, at least in theory, be equitably allocated to foster a good life for all within ecological limits. However, one could well achieve these energy reductions while having an energy system running entirely on fossil fuels. Therefore, constraints also need to be imposed on the types of power generation technologies that should be built, those that should be phased out and how quickly the phasing out should be. Such a discussion is, however, beyond the scope of this policy brief. Our underlying assumption, also discussed in the introduction, is that we do not rely on speculative negative emission technologies, hence the energy system we envision for 2050 relies solely on renewables that do not release any carbon into the atmosphere. Such a target could be reached with a mix of policies like renewables quotas, carbon taxes, and a ban on fossil fuels use.

In the next Section, we discuss the policy interventions that we deem most relevant to reach the 1.5°C target set in Paris within planetary boundaries whilst also tackling the social dimension discussed for example by Kate Raworth in the Doughnut Economics framework (Raworth, 2017). The equitable per-capita energy allowance discussed in this section sits at the core of the set of policies we propose.

5 Policy Recommendations

In *A Blueprint for Europe's Just Transition,* the authors suggest achieving the desired level of energy consumption by means of an *energy allowance*, where "all households would benefit from an amount of free energy up to a certain point necessary to satisfy essential needs: heating and cooking. Beyond that, the price would rise steeply, creating a powerful incentive for households to conserve energy." (DiEM25, 2019, p.64). To achieve the goals we have discussed in the previous sections, that is, the objective of a more equitable society that enhances the well-being of all its members while meeting the climate targets and, at the very least, also reduces pressure on the environment, the energy allowance needs to be complemented with other policies. This is because each issue requires its specific policy and because, even for one specific issue, there is no silver bullet.

In what follows we look at policies aiming at lowering income inequality, but also redesign infrastructure and transport. We do acknowledge that a much broader suite of policies would be needed (e.g., policies aiming at increasing access to the commons), but we rather focus on the ones we believe are most needed and leave the rest for a future policy brief.

Cap on wealth and income. The establishment of a maximum cap on wealth and/or income kills two birds with one stone. The income gap within countries is widening, which results in increasing intersectional inequality of societies. This can kick off a vicious circle as inequality makes legislative agendas subject to the undue influence of the rich, who tend to be against progressive social policies (The Economist, 2018; Epp & Borghetto, 2021). For example, Page et al. (2013) found that not only did very wealthy Americans attend to politics "most of the time", they also perceived budget deficits as the most important problem facing the United States, with climate change making the bottom of the priority list. Higher income is associated with more resource-intensive consumption behaviour, which exacerbates the climate crisis due to the emissions associated with the provision of the consumed products and services (Otto et al. 2019; Oswald et al., 2020). Consequently, a maximum cap on wealth and income could hamper the ability of the richest to lead ecologically devastating lifestyles. This would also reign in the undue influence of the rich on politics (e.g., Krugman, 2020), enabling society to enact a more progressive policy agenda. Promising proposals are a *maximum income* that bears some relation to a minimum income, which, once implemented, might incentivize the rich to lift the minimum income (Buch-Hansen & Koch, 2019). Caps on wealth would reign in inequality on shorter time-scales than caps on only income, but they likely face stronger political opposition and are more complicated to implement. While these policy proposals may be difficult to enact in the current political climate, inequality is at the heart of our social and ecological crises, and genuine progress will be stalled until we start to address it. Caps on wealth and income would be very efficient measures for contributing to the transition to genuinely environmentally sustainable and socially equitable societies; the exact caps should be decided democratically to avoid paternalism and lack of support (Buch-Hansen & Koch, 2019).

Progressive taxes. As discussed above, acknowledging the differentiated responsibility in the climate and ecological crises means that the costs of the transition should not be distributed equally. Progressive income and wealth taxes are thus necessary to lower inequality and when coupled with taxes on carbon and harmful (to the environment and human health) consumption goods and services, they all work to discourage social inefficiencies arising from overconsumption and profit-focused activities harmful to socio-ecological well-being (Vogel et al., 2021).

Work-time reduction. Downscaling energy consumption and providing decent living standards to all, as we have outlined in Section 4, implies less material consumption and thus a shrinking economy, which in turn also implies less production and consequently less demand for labour. Therefore, to ensure everyone can have a job or, at least, that unemployment is contained, the work-time will need to be shared among labourers (what is known as work-sharing or work-time reduction; Kallis, 2013). While there are different proposal regarding how work-time could be shared (e.g., a longer lunch break, reducing the hours worked in a day, a 3 or 4 days week-end or one week off per month; Kallis et al, 2020), the overarching benefit is that people will have more free time for reproductive, subsistence, social, and recreational activities.

Reducing work-time will lead to a reduction of work-related incomes. However, because of synergies with two other policies, a reduction in this form of income should be of no concern: (1) the policy of a universal basic income/autonomy allowance guarantees a minimum level of income and universal basic services to ensure well-being for all and (2) the policy on redesigning public infrastructure guarantees enhanced, free-on-point public transport and access to public houses. Lastly, reducing the work-time will free up time while guaranteeing decent wages; this might lead to increased consumption of environmentally harmful goods or leisure activities. The taxes discussed above on environmentally harmful goods and services help to prevent this negative outcome (Kallis et al., 2013).

Unconditional autonomy allowance/universal basic income. The proposed policy measure of an unconditional autonomy allowance (UAA) is a necessary consequence of the policy of reducing work-times and the associated lower work-related income. It also has important synergies with the policy on legislating a cap on wealth as the excess wealth can be redistributed to finance the UAA. The UAA can be and often is compared to a universal basic income (UBI). Both aim to redistribute financial resources in the economy to reduce inequality in society, to provide a minimum social safety net to ensure decent standards of living for all, and to give people the autonomy to live without dependency on paid work (Liegey, 2019). Like UBI, the UAA should be granted to everyone without any conditions attached to receiving it. However, the key difference between UBI and UAA is that the UAA incorporates a specific vision of society into its design to incentivise socially and ecologically desirable behaviours and modes of consumption (Liegey, 2013). This is achieved by dividing the UAA into a guaranteed minimum income in national currency that can be spent however the recipients wishes to, while the rest of the UAA is provided in alternative currencies that can only be used to pay for ‘desirable’, e.g. local and environmentally friendly, goods and services (Liegey, 2019).

Public infrastructure. To reduce carbon emissions and pressure on the environment while providing decent living standards to all, there is the need to (1) upgrade the current infrastructure to a low-carbon one and (2) provide the new necessary infrastructure that allows the adoption of environmentally-friendly lifestyles, thereby shaping and changing societal norms in the long run. Here, we discuss infrastructure projects related to transport and housing.

Public transport should be enhanced and be made free at the point of use. For people that live in more rural areas, where public transport might not be an option, adoption of electric vehicles (EVs) should be fostered by installing charging stations and facilitating fleet switching by providing subsidies to families in need. Train infrastructure should also be enhanced and policies that ban short-distance flights and deter frequent business flights should be introduced. The carbon tax discussed above works in synergy with these policies by making it more costly to use fossil fuel-powered transport and private vehicles.

The current house stock should be retrofitted using the most energy efficient technologies. Low cost, affordable public houses should be built and made available to the households in most need. Moreover, to be in line with the DLE scenario, there needs to be a redistribution of the living space among households; this likely means that the most affluent households would have to give up part of the space they currently occupy. Such a redistribution of living space will face strong political opposition. However, through time, when people's norms are reshaped by living in more equitable societies one can envision addressing this issue. A decision on how to distribute living space more equally should be reached via a democratic discussion, for instance by means of citizens assemblies.

6 Conclusions

The climate crisis is possibly the biggest crisis humanity has ever faced. As outlined in this policy brief, Global North countries are responsible for the lion's share of historical emissions, driving destruction that will most strongly affect the Global South. Countries in the Global North therefore bear the strongest responsibility to drastically cut emissions. With current pledges putting us on track for 3°C of warming rather than the "well below 2°C" that all nations of the Earth have committed to in Paris, much of this action is still to come.

Inequality does not stop at the North/South divide, however. Focusing on Europe, there is also extreme carbon inequality within the EU member states, with the richest 1%, richest 10%, and poorest 50% exceeding the carbon footprint by 2030 consistent with 1.5°C by a factor of 30, 10, and 2, respectively (Gore & Alestig, 2020). This suggests that a just world would also be a more ecological one. Indeed, the research we reviewed in this policy brief suggests that it is possible to achieve a decent life for all while limiting warming to 1.5°C. Focusing on Europe, we found that high levels of inequality are inconsistent with reaching this target.

If we follow the precautionary principle and avoid excessive reliance on speculative negative emissions technology and historically unprecedented and implausible 'green growth', the most promising pathway to reach our climate targets are radical demand-side solutions and a socio-economic transformation whose motto is — as George Monbiot puts it — *private sufficiency, public luxury*. This pathway would not only address the climate and ecological crises, but also lead to a much more equal society. As we have seen, this is no accident, because inequality is at the heart of these crises.

Above we listed a number of policy recommendations that would push society towards a more sustainable and equitable path. Reading them, you may well find them utopist, virtually impossible in the current socio-political climate. We believe that socio-political barriers are easier to break than geo-physical ones. On this note, a recent survey by the Global Commons Alliance found that 73% of citizens in the world's wealthiest nations — the G20 — believe that the Earth is close to irreversible "tipping points" because of human action, and their country's economy should move beyond a singular focus on profit and economic growth and instead focus more on well-being and ecological protection and regeneration (Gaffney, Tcholak-Antitch, et al., 2021). Socio-political barriers seem to be approaching their breaking point.

Lastly, we should not forget that the climate crisis will get worse before we can stabilize Earth's climate — much of the chaos is still to come. As Milton Friedman notoriously noted:

> "Only a crisis — actual or perceived — produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around. That, I believe, is our basic function: to develop alternatives to existing policies, to keep them alive and available until the politically impossible becomes politically inevitable."

The policies we suggested above may seem politically impossible. Until, that is, they become politically inevitable.

References

Alcaraz, O., Buenestado, P., Escribano, B. et al. (2018). Distributing the Global Carbon Budget with climate justice criteria. *Climatic Change, 149*, 131–145.

Allen, M., Antwi-Agyei, P., Aragon-Durand, F., Babiker, M., Bertoldi, P., Bind, M., ... & Zickfeld, K. (2019). Technical Summary: Global warming of 1.5° C. An IPCC Special Report on the impacts of global warming of 1.5° C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

Anderson, K. (2015). Duality in climate science. *Nature Geoscience, 8*(12), 898-900.

Anderson, K., & Peters, G. (2016). The trouble with negative emissions. *Science, 354*(6309), 182-183.

Buch-Hansen, H., & Koch, M. (2019). Degrowth through income and wealth caps? *Ecological Economics*, *160*, 264-271.

DiEM25 (2019). A Blueprint for Europe's Just Transition. Available at https://gnde.diem25.org/ [Accessed 6 August 2021].

Easterlin, R. A. (1974). Does economic growth improve the human lot? Some empirical evidence. In Nations and households in economic growth (pp. 89-125). Academic Press.

Epp, D. A., & Borghetto, E. (2021). Legislative agendas during periods of inequality: evidence from Europe and the United States. *Journal of European Public Policy*, *28*(4), 532-550.

Fanning, A. L., & O'Neill, D. W. (2019). The Wellbeing–Consumption paradox: Happiness, health, income, and carbon emissions in growing versus non-growing economies. *Journal of Cleaner Production, 212*, 810-821.

Fezzigna, P., Borghesi, S., & Caro, D. (2019). Revising emission responsibilities through consumption-based accounting: a European and post-Brexit perspective. *Sustainability*, *11*(2), 488.

Gaffney, O., Tcholak-Antitch, Z., et al. (2021). Global Commons Survey: Attitudes to planetary stewardship and transformation among G20 countries. *Global Commons Alliance*.

Gore, T., & Alestig, M. (2020). Confronting carbon inequality in the European Union. Oxfam Media Briefing.

Grubler, A., Wilson, C., Bento, N., Boza-Kiss, B., Krey, V., McCollum, D. L., & Valin, H. (2018). A low energy demand scenario for meeting the 1.5 C target and sustainable development goals without negative emission technologies. *Nature Energy, 3*(6), 515-527.

Haberl, H., Wiedenhofer, D., Virág, D., Kalt, G., Plank, B., Brockway, P., ... & Creutzig, F. (2020). A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights. *Environmental Research Letters*, *15*(6), 065003.

Peters, G. (2021). https://twitter.com/Peters_Glen/status/1426112990517121024 [Accessed 28 August 2021].

Hickel, J. (2020). Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. *The Lancet Planetary Health, 4*(9), e399-e404.

Hickel, J., & Kallis, G. (2020). Is green growth possible? *New Political Economy*, *25*(4), 469-486.

Hickel, J., Brockway, P., Kallis, G., Keyßer, L., Lenzen, M., Slameršak, A., ... & Ürge-Vorsatz, D. (2021). Urgent need for post-growth climate mitigation scenarios. *Nature Energy*, 1-3.

IEA 2020. CCUS in clean energy transitions (Paris: IEA). Available at https://www.iea.org/reports/ccus-in-clean-energy-transitions [Accessed 3 August 2021].

IPCC (2014). Summary for Policymakers. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (Eds.)]. Cambridge University Press.

IPCC (2018). *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]

IPCC (2021a). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

IPCC (2021b). Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel* *on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

Ivanova, D., & Wood, R. (2020). The unequal distribution of household carbon footprints in Europe and its link to sustainability. *Global Sustainability*, *3*.

Jaccard, I. S., Pichler, P. P., Többen, J., & Weisz, H. (2021). The energy and carbon inequality corridor for a 1.5 °C compatible and just Europe. *Environmental Research Letters, 16*(6).

Kallis, G. (2013). Societal metabolism, working hours and degrowth: a comment on Sorman and Giampietro. *Journal of Cleaner Production*, *38*, 94-98.

Kallis, G., Kalush, M., O'Flynn, H., Rossiter, J., & Ashford, N. (2013). "Friday off": reducing working hours in Europe. *Sustainability*, *5*(4), 1545-1567.

Kallis, G., Paulson, S., D'Alisa, G., & Demaria, F. (2020). The case for degrowth. John Wiley & Sons.

Keyßer, L. T., & Lenzen, M. (2021). 1.5 C degrowth scenarios suggest the need for new mitigation pathways. *Nature Communications*, *12*(1), 1-16.

Krugman, P. (2020, July 1). Why Do the Rich Have So Much Power? *The New York Times.*

Lenton, T. M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., & Schellnhuber, H. J. (2019). Climate tipping points-too risky to bet against. *Nature*, *575*(7784), 592-595.

Liegey, V. (2013). *Degrowth: a Strategy to Counter the Crisis?* Green European Journal. Available at https://www.greeneuropeanjournal.eu/degrowth-a-strategy-to-counter-the-crisis/ [Accessed 5 August 2021].

Liegey, V. (2019). *Degrowth and the Unconditional Autonomy Allowance (UAA): A tool for equity and dignity*. Un Projet de Décroissance. Available at http://www.projet-decroissance.net/?p=2468 [Accessed 5 August 2021].

Mattoo, A. & Subramanian, A. (2012). Equity in Climate Change: An Analytical Review. *World Development, 40*(6), 1083-1097.

McKinnon, C. (2015). Climate justice in a carbon budget. *Climatic Change, 133*(3), 375-384.

Millward-Hopkins, J., Steinberger, J. K., Rao, N. D., & Oswald, Y. (2020). Providing decent living with minimum energy: A global scenario. *Global Environmental Change, 65*, 102168.

Ohndorf, M., Blasch, J., & Schubert, R. (2015). Emission budget approaches for burden sharing: some thoughts from an environmental economics point of view. *Climatic change*, *133*(3), 385-395.

Oswald, Y., Owen, A., & Steinberger, J. K. (2020). Large inequality in international and intranational energy footprints between income groups and across consumption categories. *Nature Energy, 5*(3), 231-239.

Otto, I. M., Kim, K. M., Dubrovsky, N., & Lucht, W. (2019). Shift the focus from the super-poor to the super-rich. *Nature Climate Change, 9*(2), 82-84.

Oxfam (2021). The Inequality Virus. Published by Oxfam GB for Oxfam International.

Page, B. I., Bartels, L. M., & Seawright, J. (2013). Democracy and the policy preferences of wealthy Americans. *Perspectives on Politics*, *11*(1), 51-73.

Parrique, T., Barth, J., Briens, F., Kerschner, C., Kraus-Polk, A., Kuokkanen, A., & Spangenberg, J. H. (2019). Decoupling debunked. *Evidence and arguments against green growth as a sole strategy for sustainability. A study edited by the European Environment Bureau EEB*.

Rao, N. D., & Min, J. (2018). Decent living standards: material prerequisites for human wellbeing. *Social Indicators Research, 138*(1), 225-244.

Raworth, K. (2017). *Doughnut Economics: Seven ways to think like a 21st-century economist*. Chelsea Green Publishing.

Rockström, J., Gaffney, O., Rogelj, J., Meinshausen, M., Nakicenovic, N., & Schellnhuber, H. J. (2017). A roadmap for rapid decarbonization. *Science*, *355*(6331), 1269-1271.

Rogelj, J., Schaeffer, M., Friedlingstein, P., Gillett, N. P., Van Vuuren, D. P., Riahi, K., ... & Knutti, R. (2016). Differences between carbon budget estimates unravelled. *Nature Climate Change*, *6*(3), 245-252.

Sanchez, D. L., Nelson, J. H., Johnston, J., Mileva, A., & Kammen, D. M. (2015). Biomass enables the transition to a carbon-negative power system across western North America. *Nature Climate Change, 5*(3), 230-234.

Steffen, W., Richardson, K., Rockström, J., et al. (2015). Planetary boundaries:guiding human development on a changing planet. *Science*, 347.

Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., ... & Schellnhuber, H. J. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences*, *115*(33), 8252-8259.

Steinberger, J. K., Lamb, W. F., & Sakai, M. (2020). Your money or your life? The carbon-development paradox. *Environmental Research Letters, 15*(4), 044016.

The Economist (2018, July 21). As inequality grows, so does the political influence of the rich.

United Nations Environment Programme (2020). Emissions Gap Report 2020. Nairobi.

Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., Hakala, E., & Eronen, J. T. (2020). Decoupling for ecological sustainability: A categorisation and review of research literature. *Environmental Science & Policy*, *112*, 236-244.

Duscha, V., Denishchenkova, A., & Wachsmuth, J. (2019). Achievability of the Paris Agreement targets in the EU: demand-side reduction potentials in a carbon budget perspective. *Climate Policy*, *19*(2), 161-174.

Videira, N., Schneider, F., Sekulova, F., & Kallis, G. (2014). Improving understanding on degrowth pathways: An exploratory study using collaborative causal models. *Futures*, *55*, 58-77.

Vogel, J., Steinberger, J. K., O'Neill, D. W., Lamb, W. F., & Krishnakumar, J. (2021). Socio-economic conditions for satisfying human needs at low energy use: an international analysis of social provisioning. *Global Environmental Change*, 102287.

Wiedmann, T., Lenzen, M., Keyßer, L. T., & Steinberger, J. K. (2020). Scientists' warning on affluence. *Nature Communications, 11*(1), 1-10.

Wiedmann, T. O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., & Kanemoto, K. (2015). The material footprint of nations. *Proceedings of the National Academy of Sciences*, *112*(20), 6271-6276.