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Abstract

The nexus of COVID-19 and climate change has so far brought attention to short-term greenhouse gas (GHG) emissions reductions, public health responses and clean recovery stimulus packages. We take a more holistic approach, making five broad comparisons between the crises with five associated lessons for climate change mitigation policy. First, delay is costly. Second, policy design must overcome biases to human judgment. Third, inequality can be exacerbated without timely action. Fourth, global problems require multiple forms of international cooperation. Fifth, transparency of normative positions is needed to navigate value judgments at the science-policy interface. Learning from policy actions during the COVID-19 crisis could enhance efforts to reduce GHG emissions and prepare humanity for future crises.

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Introduction

Increasing anthropogenic influence on the natural environment over many centuries (Goudie, 2018) has led to significant global challenges at the nexus of planetary and human health, of which COVID-19 may just be the latest manifestation.[1] Although the COVID-19 crisis is distinct in contemporary history in bringing simultaneous global health and economic impacts, it shares marked similarities with the climate crisis (Fuentes et al., 2020; Rockström and Edenhofer, 2020). The pandemic and climate change both present potentially devastating global problems with need for rapid remediating government intervention. This intervention, while inevitably creating losers, in both cases must be decisive and build on societal consensus.

The global economic consequences of COVID-19 will be dramatic. The IMF (2020a) predicts that global GDP will contract by 3% in 2020, far greater than during the 2008-2009 Global Financial Crisis, while the European Commission (2020a) expects an even larger reduction of 8% for the Euro Area. Present policy debate connecting climate change and COVID-19 primarily concerns remediating these economic damages using clean recovery stimulus packages (Hepburn et al., 2020; Koundouri, 2020; Rosenbloom and Markard, 2020).[2] However, the value of side-by-side COVID-19 and climate dialogues extend well beyond short- and medium-term fiscal policy (Helm, 2020). The crises face similar challenges in addressing institutional and societal barriers against effective action. Learning from policy actions during the COVID-19 crisis could enhance efforts in fighting global climate change, as well as preparing humanity for future crises.

We draw five policy lessons from the early stages of the pandemic. First, delay is costly, but early and determined action is politically difficult. Second, broad public support is critical for early action and underestimating damages impact support. Third, inequality can be exacerbated both by the threat itself and by mitigation policies, thus placing an additional constraint on policy making. Fourth, global problems require multiple forms of international cooperation and solidarity. Fifth, transparency of normative standpoints and effective communication strategies for inoculating citizens against misinformation are needed to navigate value judgments at the science-policy interface.

For each lesson, we precipitate conclusions for effective climate policy based on the reactions of global governments to the pandemic. The lessons covered in this piece reflect assumed long-run importance for the future of climate policy. Between lessons two, three and four, we gradually move from the micro to the macro level, by going from individual support among the citizenry, to community-wide distribution of resources and burdens, to international collaboration. Though it is important to consider the response to both the COVID-19 and climate crises on each level, one should be wary of how approaches may differ between levels due to subtle differences in the phenomena. While we choose to retain a close focus on climate

[1] Climate change and a surge in zoonose pandemics such as COVID-19 both result from human interference with natural environments (Settele et al., 2020). In fact, the occurrence of new pathogens such as Ebola, HIV, Marburg or SARS seems to have sped up in recent years as a consequence of human expansion into remote ecosystems (Johnson et al., 2020).

[2] A related discussion concerns reductions in GHG emissions that resulted from the pandemic and its economic consequences: Le Quéré et al. (2020), for instance, estimate that by mid April 2020, daily global CO2 emissions are on average 17% below their mean 2019 levels.

change mitigation, it may be a worthwhile exercise for future research to extend the analysis to adaptation or discern additional adaptation-specific lessons from COVID-19.

While COVID-19 demonstrates that, in a globalised world, infectious disease can bear striking similarities to known global commons problems, a marked difference is that climate change mitigation necessarily relies on much more anticipatory and global responses. Unlike the climate crisis, epidemiological challenges create incentives for localized mitigation and immunization and unfold over shorter timescales.

On balance, this article provides evidence that climate change is more difficult to confront than the current pandemic in many ways (Figure 1) but that there is potential for lessons to be learnt from new approaches in a post-COVID era. This article integrates perspectives from environmental economics, behavioural and political science, and philosophy of public policy to draw lessons from COVID-19 and articulate a forward pathway for future climate policy proposals and their communication.

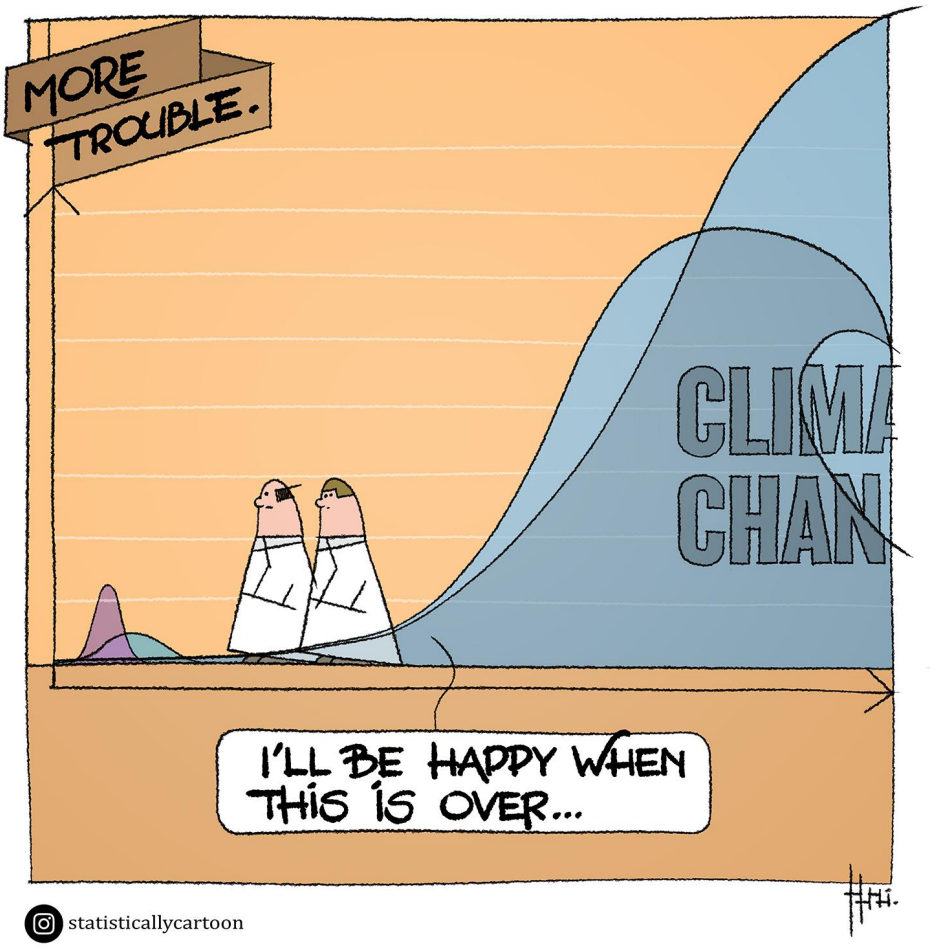

Figure 1: *Reprinted with friendly permission from Raf Schoenmaekers. (https://www.instagram.com/statisticallycartoon/)*

Lesson 1: Delay is costly, so make mitigation a priority, now

The current pandemic shows that political leaders have a tendency to react slowly in the face of unprecedented threats. Few countries reacted quickly and slowed the progress of SARS-CoV-2 in its early stages: while Hong Kong, South Korea, Singapore and Taiwan drew from experience with epidemics in recent decades, some countries without this experience such as Czechia or Greece also managed to slow the progress of the virus early on.[3] A majority of countries, especially those lacking recent experience with viral outbreaks, acted decisively only after local virus transmission had occurred and a large number of cases were reported, despite evidence of the gravity of the situation from other countries. On 2 March the European Centre for Disease Prevention and Control released recommendations to cancel mass gatherings in countries with locally transmitted cases (ECDC, 2020) and the World Health Organization declared the coronavirus outbreak officially a pandemic on 11 March (WHO, 2020a). However, in the first two weeks of March, there were still a large number of mass gatherings in many European countries, including soccer matches and demonstrations. Even after witnessing the dynamics of the pandemic in China and Europe, there was a delay in the introduction of nationwide measures such as school closures and social distancing guidelines in the US, which were eventually implemented on March 16 (New York Times, 2020a). At the time of writing, the US is the country with the highest number of confirmed COVID-19 cases as well as deaths worldwide.

Delays in containment measures during global crises are all the more tragic as earlier action reduces costs and damages dramatically. In the case of COVID-19, acting early has made the difference between a prolonged full-scale lockdown and a high number of casualties, and much less dramatic measures such increased health screening at borders, contact tracing, public information campaigns and almost business-as-usual as for example in Taiwan (see Wang et al., 2020). In the early stages of the pandemic, it has been estimated that delaying some form of lockdown by a single day increases the numbers of cumulative cases by 40% (Pueyo, 2020). For the United States, Pei et. al (2020) estimate that starting social distancing one week earlier could have avoided 55% of deaths (36,000) between mid March and early May. Once a lockdown is implemented after a delay, it has to be maintained for longer, increasing not only casualties but also economic losses. Figure 2 compares the evolution of COVID-19 cases per capita in different countries.

On much longer time scales, decisions on climate policy also need to account for the fact that delay is very costly. Earlier action might reduce mitigation costs significantly (Dietz and Venmans, 2019; Goulder, 2020): The latest report of the Intergovernmental Panel on Climate Change (IPCC, 2018) stresses the importance of limiting global warming to 1.5°C instead of 2°C by the end of this century to avoid tipping points and irreversible changes in our environment. It highlights, in particular, that delayed climate action implies significantly higher costs, as it locks economies into carbon-intensive infrastructure, reduces flexibility in future response options and increases uneven distributional impacts between countries. More specifically, a meta study of 16 Integrated Assessment Models shows that delaying climate

[3] Although these countries avoided overwhelmed health care systems and in some cases complete economic shutdowns due to early action, the pandemic is still ongoing and case numbers change on a daily basis. In particular, Singapore has faced a large increase in cases in early April (Lai, 2020).

action by ten years increases the cost of later climate action by 37% (Furman et al., 2015). In a similar vein, a 2012 model comparison study estimates that delaying climate policy compatible with 2 degrees warming by the end of this century until 2020 would increase mitigation costs by around 50% (Jakob et al., 2012).

The effects of climate change that are currently experienced, such as climate change-related extreme weather events, wildfires and sea level rise, are only mild harbingers of projected future climate damages (IPCC, 2014a). The political reaction to the COVID-19 pandemic suggests that societies have a tendency to take action too late in the face of a looming crisis, despite witnessing signs of escalation. Moreover, they take too long to actually implement policies. Ideally, the current crisis would make decision-makers and institutions aware of the immense costs of delaying climate actions and increase their responsiveness to climate change, similar to how countries with recent experience with viral outbreaks had a better responsiveness to COVID-19. However, even when policy-makers are alerted to the urgency of climate change mitigation, decision-making in the context of climate change is further complicated by political economy constraints, in particular the efforts from industry lobbyists to delay or weaken emission reductions. In addition, early action is not popular if citizens are not convinced of the severity of the consequences (see Lesson 2). Conversely, if early policy responses are very effective, they can be perceived as an overreaction in hindsight, which may disincentivize politicians to implement anticipatory measures, especially when they have high costs.[4] To the extent that policy-making is constrained by public opinion, behavioral biases among the citizenry might therefore further aggravate the problem of delay, as we discuss in the next section.

[4] This may be due to omission bias (Baron and Ritov, 2004), which leads people to prefer harms caused by omissions over equal or smaller harms caused by acts.

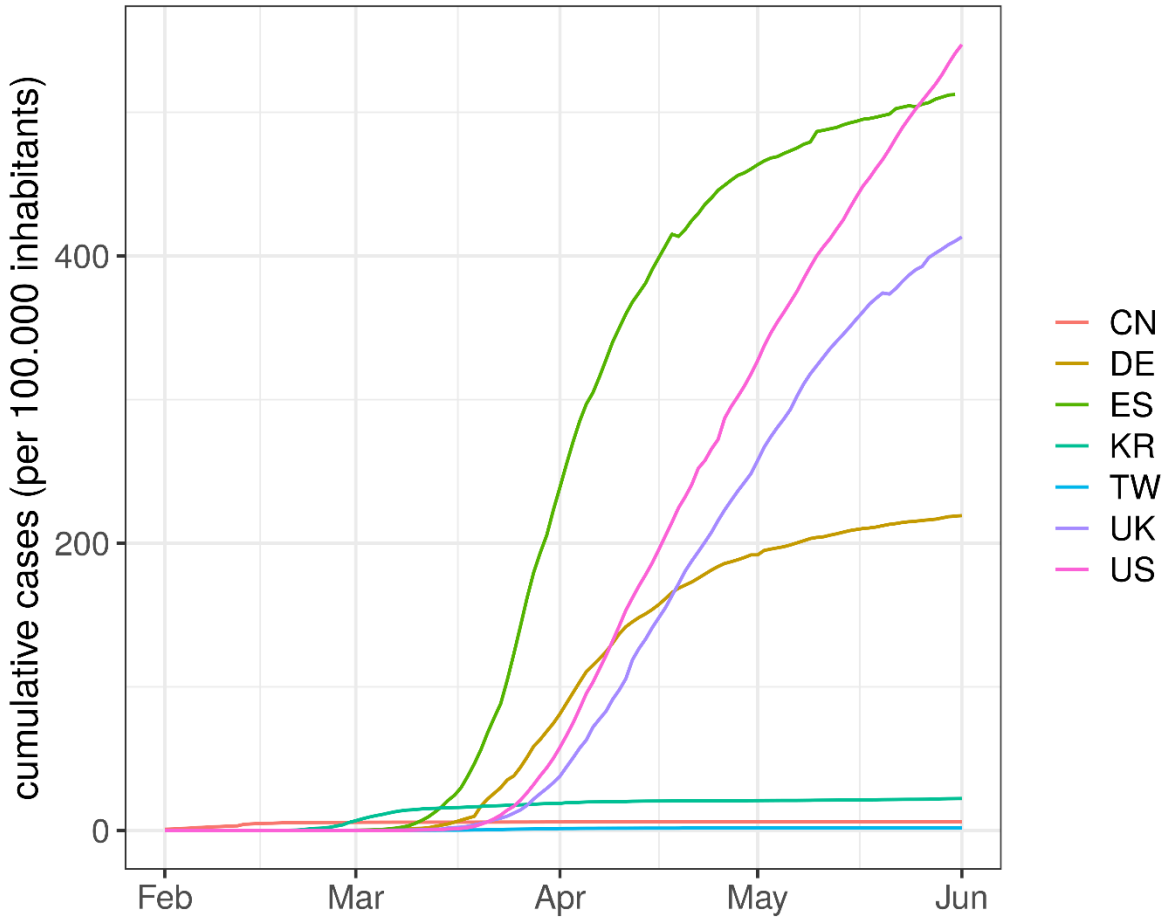

Figure 2: *COVID-19 cases per 100.000 inhabitants. Source: Own calculations based on data from the European Centre for Disease Prevention and Control https://www.ecdc.europa.eu/*

For climate policy, contrary to policy responses to COVID-19, decades of research and policy development mean that policy makers are starting from a much higher knowledge base and have years of experience to build on. The COVID-19 pandemic also illustrates that countries can adopt policies pioneered by frontrunners, once they turn out to be successful. As the spread of the virus aggravated, many countries eventually converged to similar policy responses: social distancing.[5] Similarly, there are climate policy pioneers: countries which introduced high carbon prices (e.g. Sweden and Switzerland) or other policies through which they dramatically lowered their carbon footprint (coal phase-outs, climate legislation, low-carbon technology subsidies). Policy makers can look towards these countries to find inspiration for suitable policy responses and adapt them to local circumstances.

If an undue focus on the immediate future in policy making is a major obstacle to advancing climate change mitigation, societies could agree to delegate responsibility for delivering emission reduction to carbon central banks, by analogy to the role of central banks for monetary policy (Helm, Hepburn and Mash, 2003; Grosjean et al., 2016). A milder form of delegating such responsibility could be to create independent expert bodies with a mandate

[5] Proposals to let the virus spread to attain herd immunity were in most cases abandoned in the early stages after Ferguson et al., (2020) estimated the number of casualties of such a policy to be in the order of 250,000 in the UK and to exceed one million in the US.

to recommend policy action to the government and stimulate related public debate, as pioneered by the United Kingdom and its Committee on Climate Change (Averchenkova, Fankhauser and Finnegan, 2018).

Lesson 2: Find ways to get citizens on board

In the early phases of the pandemic, a lockdown of the economy as implemented in the Chinese province of Wuhan would have seemed unimaginable to most nations outside of South-East Asia. Indeed, most countries hesitated to introduce strict and unpopular measures to stop the pandemic early on, in particular if they lacked previous experience with epidemics. Public support for specific measures to stop the spread of the virus increased when citizens perceived the threat as severe or imminent enough (for the United States see Ipsos, 2020). Whether strict measures to mitigate pandemics or climate change are practically available to policymakers depends at least in part on public perception of the severity of these threats.

There are several effects at play that influence how people perceive and respond to different threats. First, the human brain has difficulties understanding non-linear dynamics (de Langhe et al., 2017), in particular exponential growth (Levy and Tasoff, 2017). The spread of pandemics like COVID-19 is governed by exponential growth processes. This bias lets the pandemic appear unimpressive in its early stages, which causes delays in this phase. Second, whether a threat is perceived as “imminent” changes reactions to it dramatically: As SARS-CoV-2 has spread globally and has received excessive media coverage, the threat of dying from the virus is more salient. COVID-19 is perceived as a particularly bad way of dying in the sense that people have little control over contracting the disease and the way it proceeds, as well as being a painful and relatively long process (Draulans, 2020). Society is willing to pay relatively more to avoid such “bad deaths” in general (Sunstein, 1997). COVID-19 exemplifies this as societies are paying a high price to avoid the threats of the pandemic, both financially and in terms of restrictions such as lockdowns. Third, when people need to decide under uncertainty whether to respond to a threat, they rely on certain heuristics (Tversky and Kahneman, 1974). While this is often an effective strategy, it might lead to biased outcomes. When assessing the probability of a pandemic in their region, humans rely on their own past experiences and determine the probability by the ease with which similar past events come to mind. This effect is called availability heuristic (Tversky and Kahneman, 1973) and leads to an underestimation of the dangers of a COVID-19 pandemic in the early stages in countries without experience of pandemics in recent decades and hence to a lack of support for policy measures and to slow policy action.

In the case of climate change, similar mechanisms are at work that make its danger to human well-being difficult to grasp. It has been shown that the relationship between warming and damages is non-linear, due to tipping points and feedback effects in the system (Burke et al., 2015; Lenton 2020). This makes the dynamics of climate change especially hard to grasp and leads to an underappreciation of goals like limiting warming to 1.5° C. Regarding the perceived imminence of the threat, climate change gives the illusion that it could be controlled to some extent, and that it does not impact one’s life in an immediate way. Whether or not this is actually the case, the perceived properties of climate change make it difficult to raise the awareness it deserves and to take early action (Markowitz and Shariff, 2012). This makes climate change a more abstract threat compared to COVID-19. Judging from respective

societal responses, dying from SARS-CoV-2 is apparently worse than dying from consequences of environmental pollution: an outcome that can hardly be justified from moral principles (Sunstein, 1997).

The perceived imminence of a threat has further implications. Depending on the nature of the threat, personal liberties are perceived differently. On the one hand, once disaster strikes, most citizens are generally collaborative and accept harsh limitations on their freedoms, at least temporarily. On the other hand, citizens are less willing to accept very minor limitations on their liberties, such as higher taxes on fuel, meat or air travel, when the threat does not appear imminent. Figure 3 is a simple illustration of the potential relationship between the perceived consequences of a threat and society's willingness to respond to it.

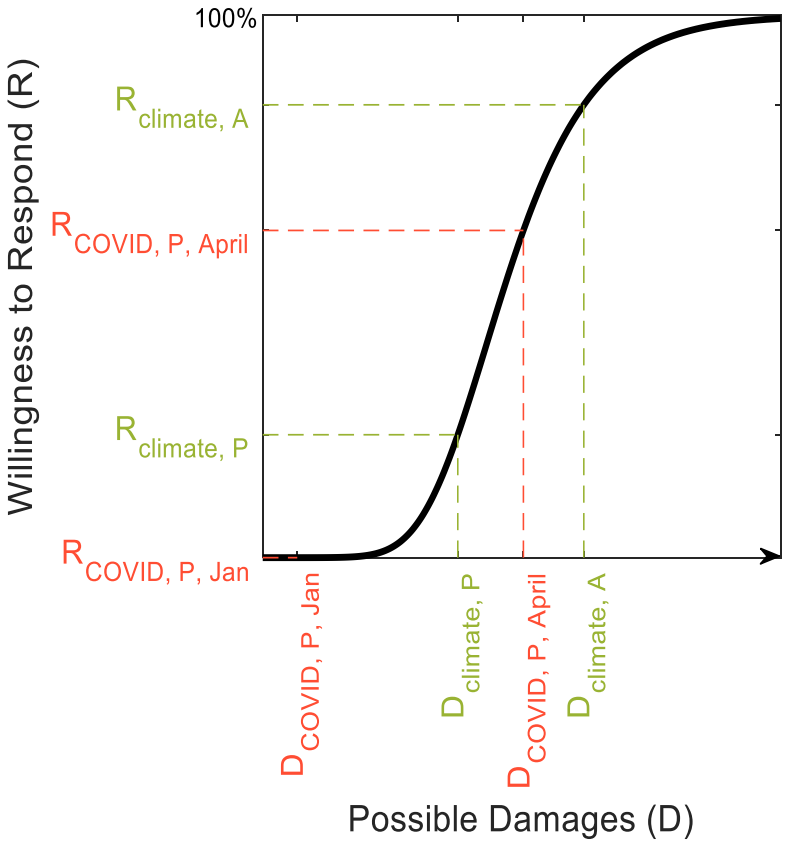

Figure 3: *Conceptual damage-response curve. Actual severity of possible societal climate damages $D_{climate,\ A}$ are significantly greater than perceived severity $D_{climate,\ P}$. Actual damages are likely to increase over time due to inadequate intervention (not shown). Perceived (and actual) damages of COVID-19 in April 2020 $D_{COVID,\ P,\ April}$ are greater than perceived damages in January 2020 $D_{COVID,\ P,\ Jan}$ where for most of the world perceived possible damages were below the level required to prompt meaningful intervention. Upward shift in perceived damages was due to more complete information, as well as higher perceived imminence of the threat, while upward shift in actual damages (not shown) was due to inaction. Logistic model curvature assumption is purely conceptual. Understanding curvature characteristics reflects opportunity for future work.*

Ultimately, political support is largely driven by moral intuitions, not rational deliberation (Haidt, 2001). Markowitz and Shariff (2012) emphasise six main challenges from climate change to the human moral judgement system: (i) abstractness and cognitive complexity; (ii) blamelessness of unintentional action; (iii) provocation of self-defensive biases; (iv) uncertainty leading to wishful thinking; (v) tribalism; (vi) long time horizons and faraway places. There is reason to believe that the first four factors apply to COVID-19: van Bavel et al. (2020) note especially the uncertainty whether social interaction will actually lead to infections as a factor that reduces individuals' motivation to act altruistically. However, with regards to (v), tribal politics on pandemic responses seems so far limited to a few highly polarised countries and (vi) does not apply, making climate change arguably the harder challenge for human moral judgement.

Awareness of these psychological factors may help to enhance society's responsiveness to crises like COVID-19 and climate change (van Bavel et al. 2020). As climate change is more difficult to grapple with on a psychological level, increasing awareness for the urgency of the threat and clear and open communication with citizens are crucial (Atansah et al., 2017, Marshall et al., 2018).

An observation that seems consistent across different countries is that, while there are broad majorities in favour of more ambitious climate change mitigation in general, support for concrete measures is lacking (Douenne and Fabre, 2020; Süddeutsche Zeitung, 2020). Rather than focussing only on the comparative efficiency of mitigation options, economic advisors and policymakers should therefore focus on garnering public support, for example by designing and communicating carbon pricing policies that appeal to taxpayers (Carattini, Kallbekken and Orlov, 2019, Klenert et al., 2018a). Pricing greenhouse gas emissions only makes sense as part of a larger policy package including green public spending, emission standards and compensatory transfers, depending on the circumstances (Stiglitz, 2019).

Further methods to enhance support are as follows: First, one such set of measures could include, for instance, using the revenue for complementary green investments to provide local tangent benefits to citizens (Douenne and Fabre, 2020). Additional measures could involve emphasizing local and tangible co-benefits such as better air quality, although evidence on the effectiveness for increasing public support is not conclusive (Bain et al., 2016; Bernauer and McGrath, 2016). Second, governments need to account for a wide variety of fairness concerns (Maestre-Andrés et al., 2019) and compensate for potentially regressive effects of climate policy (Klenert et al. 2018 a,b) to enhance support. For example, all governments that have introduced carbon taxes were able to do so by carefully designing revenue-recycling. Finally, timing of introduction of different policy instruments is key[6] – climate policies need to be faded in at opportune moments, for example when fuel prices are low (Benes et al., 2015) and in careful iteration with complementary policy measures (Pahle et al., 2018).

Beyond recommendations for increasing public awareness and support for the danger of climate change, societies may need to reform or add institutions that will take responsibility for

[6] Singer and Mintz-Woo (2020) point out that low fossil fuel prices as a result of the current recession present an opportune moment for introducing higher carbon prices. It may be, though, that politicians and citizens are currently even more averse to Pigouvian taxes (Kallbekken et al. 2011) than during times of stable economic growth.

delivering emission reductions faster (see also Lesson 1). Furthermore, France and the United Kingdom have very recently created Citizens Assemblies on Climate Change – whose work is not concluded at the time of writing – to bolster public support for further climate policy reform and, in the case of France, to counter public opposition around the protests of the Yellow Wests to higher fuel prices (European Climate Foundation, 2020). These assemblies are currently pushing for a green recovery from the COVID-19 crisis (Farand, 2020). Anecdotal evidence from the assemblies seems to indicate that many citizen participants expressed surprise at the evidence that the impacts of climate change will be damaging to their societies (Conseil économique social et environnemental, 2020; Pouliquen, 2020).

Lesson 3: Inequality can lead to worse outcomes

The COVID-19 pandemic illustrates that countries are not immune to the threat of infectious disease in a manner independent to their wealth. Even if a country manages to avert a large number of cases and a full lockdown, it will still be affected by the virus indirectly, through the ensuing slump in economic activity. Similarly, while rich households have more means to protect themselves from virus exposure and often have better access to health care, their professional situations and investments may also be affected by the economic downturn. In a globalized world, domestic economic prosperity in one country is tied to economic stability in the rest of the world, as has been demonstrated by the global financial crisis.

For a number of reasons, however, the pandemic has the potential to disproportionately burden the poor (von Braun et al., 2020): low-income countries (LICs) are more vulnerable to COVID-19 as population density is higher, a greater proportion of the population suffer from pre-existing health conditions, and healthcare systems are generally less prepared for a pandemic (Stiglitz, 2020). Further, many LIC economies are export-oriented, meaning that a global reduction in demand could be economically devastating.

Within countries, it appears that the economic consequences, from both the virus itself and the measures to contain it, deepen existing inequalities even further, as already disadvantaged groups are most affected (Adams-Prassl et al., 2020; Fana et al., 2020, OECD, 2020). Policymakers in countries with little informal employment made huge efforts to rapidly compensate citizens who lost their job or had to close their business temporarily due to the COVID-19 pandemic or containment measures. Apart from alleviating economic hardship, this policy also has the purpose to enhance trust in the government to ensure that people support containment measures. In countries with large informal sectors and a constrained budget, often LICs, such compensation policies for disadvantaged or especially affected households are less feasible. As a consequence, fewer people might be willing or able to comply with confinement measures, as they are forced to continue daily economic activities to ensure subsistence.

Regarding climate change, there is evidence that the poor will also be disproportionately affected by the related damages (IPCC, 2018; Leichenko and Silva, 2014; Letta et al., 2018) while having fewer resources to adapt to climate change. This implies that climate change damages are likely to deepen existing inequalities even further (Ahmed, 2009). When this is taken into account, model simulations find that greater global mitigation efforts are optimal

(Dennig et al., 2015) at least when especially affected households are not explicitly compensated for climate damages (Kornek et al., 2019).

While the COVID-19 pandemic proceeds at a very high speed, climate change policy, while urgent, allows more time for planning compensatory mechanisms that are known to work even in LICs with large informal sectors. In the case of climate change policies, recent research has demonstrated that there is no necessary trade-off between strict climate policy and inequality if policy is designed adequately (Dorband et al., 2019, Goulder et al., 2019; Klenert and Mattauch, 2016; Klenert et al., 2018b, Kornek et al., 2019). Even in countries with large informal sectors, there are ways to compensate citizens, given enough time for preparation, as demonstrated by the case of fossil fuel subsidy removal in India and Iran (Atansah et al., 2017).

Lesson 4: Global problems necessitate (global) collaboration

Historically high levels of global interconnectedness (Starnini et al., 2019) enabled SARS-COV2 to propagate rapidly across national borders, sparing but a few countries (Eliasaf and Tia Motwany, 2020). Responses to the virus have required a global perspective. While each nation implemented its own containment measures in isolation (see Hale et al., 2020), international collaboration on vaccine development (WHO, 2020b), supply line controls (Krohs et al., 2020), and knowledge sharing have been vital to supporting health and economic outcomes.

There are at least four observations on COVID-19 international collaboration that are relevant to climate change: COVID-19 has negatively affected all countries, the level of international collaboration has changed over the crisis, the role of multilaterals has been brought into question, and previously insurmountable political impediments have been overcome.

A global crisis with domestic consequence

First, COVID-19, like climate change, is a crisis that impacts all nations. High Income Countries (HICs) including the United States and the United Kingdom, have seen significant deaths (Roser et al, 2020; Lambert, 2020), unemployment spikes (Kretchmer, 2020), and economic contractions (IMF, 2020a). For some Low- and Middle-Income Countries (LMICs) consequences also include critical food shortages (GRFC, 2020) and increases in poverty rates (Sumner et al., 2020; Akiwumi and Valensisi, 2020). Climate change is a similarly global problem – the impacts of warmer climates and increased natural disaster prevalence will be felt by all countries, and as described in Lesson 3, most acutely in LMICs (Tol et al., 2004; Mendelsohn et al., 2006; IPCC, 2018; CRED and UNISDR, 2018). Much of the worst impacts of COVID-19 could have been avoided by early international collaboration, for example in the form of coordinated travel restrictions against passengers departing from China (Kraemer et al., 2020; Schuchat in Stobbe, 2020). For climate, ongoing inaction from the biggest polluters including China, the United States and India (Ritchie and Roser, 2019) will increase total damages, increase recovery uncertainty and decrease accountability for other nations to set aspirational domestic targets. COVID-19 failures suggest that large polluters must act rapidly and decisively on climate action to avoid a significantly more dangerous future and difficult recovery pathway. Further, slow international responses to the virus suggest that in future

global crises, nations should heed the advice of those which endure the earliest effects – for instance taking seriously the pleas of sinking Pacific island nations (Farbotko, 2010).

The phases of international collaboration

International collaboration has grown over the course of the COVID-19 response. We suggest that this process is best described by four phases. First, in the early stages of the pandemic, denialism led to inadequate international responses. The World Health Organisation (WHO) was mobilised to provide international guidance in early January (WHO, 2020a), but the severity of the virus was masked for a number of weeks, and nations largely ignored the threat until consequences were felt on home soil (see Hale et al., 2020).

This was followed by a second phase of response: isolationist action, in the form of border shutdowns, sudden buildout of domestic manufacturing capabilities, and rhetoric prioritising internal objectives ahead of cooperation (Gabriel, 2020; Legrain, 2020). For the US, uncertain international procurement pathways for medical supplies led to aggressive international competition (Bradley, 2020) as well as new domestic production including ventilators (Trump, 2020) and masks (Shepardson, 2020). In many geographies, these actions were accompanied by increasingly hostile international relations (Thorp, 2020), particularly between China and the West (Seaman, 2020; Marquadt and Hansler, 2020).

Most HICs have now moved to a third stage of international collaboration: knowledge and resource sharing. In some nations, notably the US and EU member states, management of medical supplies, including masks and ventilators, shifted from hoarding to sharing (Melville, 2020, Myers and Rubin, 2020, European Commission, 2020). In a marked development from stage two, some countries are prioritising learning from and consulting with other nations. For example, the Australian National Cabinet invited a foreign Head of State, New Zealand Prime Minister Jacinda Ardern, to join a Cabinet meeting for the first time in history (Department of Prime Minister and Cabinet, 2020).

The fourth and final stage is full global cooperation. Once a vaccine has been developed, global supply infrastructure will need to be coordinated to ensure rapid production and dissemination (Corey et al., 2020, Peters and Greening, 2020). Further, as per recent comments from Chinese leader Xi Jingping, depending on which actor develops the vaccine, it may be released as a global common good (Wheaton, 2020), in which case coordination would be even more paramount to optimal delivery. Stage 4 collaboration will begin for many countries prior to widespread adoption of a vaccine, for example in establishing 'travel bubbles' between virus-free geographies (Lee et al., 2020, Whiting, 2020). Australia and New Zealand are already in the process of establishing a Trans-Tasman virus-free bubble, with the possibility to include Taiwan, Vietnam and others before the end of the year (The Economist, 2020).

These four phases of international collaboration are analogous to phases of international collaboration on climate. For many nations, denialism was the modus operandi in the early 2000s, and for a minority it continues today.[7] Many, if not most, nations operate in a state of climate isolationism, acting on climate-positive initiatives only when domestic non-climate

[7] Eight parties (out of 195) have not ratified the Paris Agreement on Climate Change and the United States is set to withdraw from the agreement on November 4, 2020 (Apparicio and Sauer 2020).

benefits can be captured. For example, Australia has invested heavily in renewable energy supply (de Atholia et al., 2020) for economic objectives in securing cheap long-term electricity but has been a conservative actor at international climate negotiations, such as Madrid's COP25 (Morton, 2019). Other countries, including many EU nations, can now be classified as stage three actors on international collaboration. These nations are binding together to encourage broad-based mutual climate action, for example through ambitious ratchets of Paris Nationally Determined Contributions (NDCs), the proposed European Green Deal of the European Commission (2019), and through green approaches to COVID-19 recovery. The fourth stage of full international cooperation is currently aspirational for all nations. It would reflect full, practical, collaboration to meet ambitious domestic targets and financially supporting LMICs to meet similarly ambitious growth-adjusted climate targets.

From COVID-19, we learn that accelerated and well-organised collaboration in global crises can be pivotally important. However, parties need to be aligned on the fundamental goals of their collaboration else the impact of efforts will be significantly weakened. In climate, this suggests that (i) countries already engaging in resource and information sharing should be encouraged to enhance collaboration by developing specific quantifiable agreements, for example, clear numbered goals on industry emissions standards, and (ii) focus should be directed to the large emitters that do not already take the threats of climate change seriously since domestic action in these nations could have especially large spillover effects.

Multilaterals and polycentric governance

COVID-19 has brought renewed attention to the operations of many multilateral institutions. The virus has exposed weaknesses in the WHO (Freedman, 2020), culminating in a funding freeze from Washington (The White House, 2020). However, at the same time, strength in the International Monetary Fund (IMF) and the United Nations Conference on Trade and Development (UNCTAD) has led to global coordination of funds raising and debt relief to enable LMICs to act for health and economic outcomes. At the time of writing, the IMF has already coordinated US$22bn in emergency financing and US$0.2bn in debt relief (IMF, 2020b). Regional multilaterals like the African Development Bank and Asian Development Bank also acted quickly, providing both short- and long-term relief facilities of US$10bn and US$20bn respectively (AfDB, 2020; ADB, 2020).[8]

On climate, the role of multilaterals has been stressed before (Bulkeley and Newell, 2010; Aldy, 2014; Kornek and Edenhofer, 2020), particularly in directing expertise and capital to LMICs seeking simultaneous economic and climate outcomes. COVID-19 demonstrates the need for these institutions to remain apolitical in giving evidence-based advice and setting policy. In the lead up to COP26, multilateral institutions should guide constituents towards a collaborative green recovery, serving as a channel for information sharing and a platform for mutual edification. This could be achieved through a Sustainable Recovery Alliance as proposed in a recent UK government briefing (Allan et al., 2020). Such an alliance could represent a 'coalition of the willing' and "provide a forum for nations to avoid a race to the

[8] Apart from coordinating cooperation on COVID-19 mitigation, such as cross-border sharing of medical supplies and hospital capacities (see European Commission, 2020b), the European Commission just recently decided on a €750bn recovery plan with spending explicitly tied to sustainable goals (European Commission, 2020c).

bottom, to learn from one another, and to coordinate their recovery packages for greater impact".

In parallel with advancing multilateral efforts, polycentric approaches to climate governance, tying in sub-national actors such as local and regional governments, civil society organizations and businesses, may increase local experimentation and learning, hedging against the possibility that mitigation efforts on the national and multilateral level stall (c.f. Ostrom, 2010; Victor et al., 2019). COVID-19 not only showcases the importance of local and regional capacities and institutions, which were at the forefront of implementing context-appropriate responses to the pandemic (Perez and Ross, 2020), but also demonstrates that polycentric governance approaches and division of political power can sometimes be a safeguard against national inaction: while the US federal government hesitated to implement stringent physical distancing measures, some state governors and municipal governments stepped in and compensated for an initial lack of leadership at the national level (Balz, 2020). Of course, other governors did not step in, illustrating that subnational action can go both ways. In climate governance, a subset of US municipal governments and businesses promised to uphold the US mitigation pledges, when the national government decided to withdraw from the Paris Agreement (World Resources Institute, 2019). Bolstering regional and local governance capacities with respect to climate mitigation can make the transition more resilient to a lack of national leadership.

Overcoming the partisan divide

Willingness to impugn social freedoms in COVID-19 responses has varied across the political spectrum. Right-of-centre political actors – those who tend to support a smaller role of the state – expressed less concern about COVID-19 in the early stages of the virus (Pierre, 2020; Harper et al., 2020; Rosenfeld et al., 2020) and now tend to favour accelerated removal of mobility restrictions (Brownstein, 2020). Importantly, while government speed and severity of action varied across the political spectrum, once the consequences of inaction became abundantly clear, most HIC governments ultimately did introduce freedom-restricting lockdown policies for citizens. On the apparent contradiction of border closures, which were often supported more vigorously by right-of-centre actors, we interpret these as measures introduced to restrict the freedoms of outsiders as in most cases arrangements were made to allow citizens to return to their homes.

In climate conversations, a similar political divide has emerged in many countries (Tranter and Booth, 2015; Fielding et al., 2012; Antonio and Brulle, 2016) with prominent attempts to overcome it (Climate Leadership Council 2019). Again, government willingness for intervention is based on the perceived consequence of inaction which seems to be higher for left-of-centre actors than for right-of-centre actors. This suggests that some right-of-centre individuals, regardless of income or education level, may not deem intervention to be justified until potential consequences of climate change are more acutely felt (Zanocco et al., 2019). These conversations should be supported with reference to core conservative values including the centrality of upholding and strengthening all that is good in what has come before (see Scruton, 2012; Whitmarsh and Corner, 2017; Marshall et al., 2018). Climate change reflects a threat to the established social fabric of society as well as to the natural environment. Where it already exists, commentators and leaders should draw attention to successful bipartisan action as it can enable less biased reasoning and reduced polarisation (van Bavel et al., 2020).

Lesson 5: Scientific policy advice is never value-free

The COVID-19 pandemic has put scientific expertise into an unusual spotlight: in many countries, virologists and epidemiologists are receiving unprecedented media attention, with some reaching regular audiences in the millions through social media or podcast formats (New York Times, 2020b). The scientific community has been hailed for demonstrating rapidness and a high level of international collaboration in the response to SARS-COV2 and for the development of a vaccine (Kuperschmidt, 2020, New York Times, 2020c). At the same time, the role of science in the decision-making around COVID-19 has also been seen as ambivalent. Epidemiologists and virologists were accused of overstepping their mandates in exerting influence on public opinion about response measures to COVID-19 (Zakaria, 2020).

One complication for science-backed policy responses in light of the novel pandemic is that scientists disagree about appropriate ways to confront it. For example, this concerns the efficacy of face masks (Guardian, 2020a), or the role that children play in transmitting the virus, resulting in sometimes contradictory policy advice, such as regarding the reopening of schools (Mallapaty, 2020).

COVID-19 has further entailed a cascade of misinformation and conspiracy theories (Grey Ellis, 2020; Benson, 2020), anticipated since before the pandemic (see New York Times, 2019). While some of the sources of misinformation speculate about the origins of the virus or miracle cures, other sources spread doubts about the gravity of the situation and animate people to disregard government measures. Commonly, misinformation provided has the potential to put lives at risk, and the United Nations has announced an initiative to counter the current “infodemic” (UN News, 2020).

In addition, the current pandemic showcases that policymakers and citizens struggle with the uncertainty surrounding preliminary scientific evidence (see Zakaria, 2020; Mack et al., 2020; Manski, 2018). In secondary education and the media, science is often presented as a set of irrevocable facts rather than a method of rigorous evidence-gathering to confirm or reject hypotheses in a setting of inherent uncertainty (Douglas, 2017). As a result, citizens may feel disoriented when they see ‘facts’ change or experts disagree. From this viewpoint, a change in epidemiological or climatic projections is easily interpreted as failure or incompetence of scientists, rather than the normal process of science in the light of new evidence (Mack et al., 2020). This may trigger fear and mistrust in science and provide fertile ground for conspiracy theories.

The momentum for expertise in the context of COVID-19 therefore casts new light on two questions: (i) What role should scientific advice, especially from the natural sciences, have for policy making? (ii) How far should the mandate of scientific policy advisors extend? First, it must be recognised that scientific expertise with relevance to public policy is always value-laden (Steele, 2012; Rudner, 1953; Douglas, 2009). Where possible, those value judgments need to be made transparent so they can be subjected to public deliberation and democratic control.

Second, we suggest that there is a difference between speaking to the efficacy and the proportionality of a measure, with consequences for the appropriate mandates for scientific policy advisors from different disciplines. To comprehend the scale, damages and likely

trajectory of evolving crises like COVID-19 and climate change, empirical evidence is indispensable, be it from epidemiological and geophysical, or descriptive social science. The same is true in order to understand the potential efficacy of specific mitigation strategies. In order to make a judgment on the proportionality of a measure, in how it aligns with other societal goals, however, decision-makers cannot solely turn to epidemiologists, or geophysicists. Whenever measures entail social, economic or ethical tradeoffs, their endorsement entangles more specific normative value judgments. Therefore, policymakers need to inform their choices not only by expertise from the natural sciences, but should also tie in expertise from the social sciences and ethics. Depending on their specific expertise, the appropriate mandate of scientific policy advisors may sometimes be limited to speaking to the efficacy of a measure, while judgments about its proportionality require a broader consideration of different normative standpoints and public debate.

The appropriate mandate of a scientific policy advisor has to reflect both the inherent value-ladenness of scientific policy advice in general, and the specific roles and limits of expertise from different disciplines. Given these limitations, the role of an academic as policy advisor is therefore neither that of impartially outlining coherent options to a politician nor that of a technocrat taking decisions themselves, but that of a “broker” involving the politician in a conversation about potential solutions (see Pielke Jr., 2007; Edenhofer and Kowarsch, 2015; Groom and Hepburn, 2017).

At the intersection of science and policy, the COVID-19 pandemic and climate change share several commonalities. First, similarly to COVID-19, policymakers rely on the results of scientists, especially from the natural sciences, to inform climate policy goals and discern the potential efficacy of mitigation measures. For instance, the social cost of carbon (SCC), which is a central economic measure of the damages associated with emitting one additional ton of carbon, was used to inform carbon pricing policy in the US and Canada (see Environment and Climate Change Canada, 2016; Greenstone et al., 2013; US Interagency Group, 2016). Second, epidemiological models and models in climate science share their reliance on assumptions and as a consequence, results have an inherent element of uncertainty. This is illustrated by the fact that results in the influential IPCC assessment are reported jointly with the corresponding degrees of uncertainty (Mastrandrea et al., 2011). Third, climate scientists are facing similar problems around misinformation, science scepticism, and science politicization as with the COVID-19 pandemic (Allgaier, 2019; Farrell, McConnel and Brulle, 2019). Research suggests that ideologically-motivated framing of climate change in the media and “echo chamber effects” were among the main drivers of partisan polarization over climate change in the US (Carmichael, Brulle and Huxster, 2017; Bolsen and Druckman, 2018). For the US, partisanship and politicization of climate science have further been found to undermine the message of a scientific consensus on climate change (Bolsen and Druckman, 2018).

Nevertheless, there is one important distinction between the evolving COVID-19 pandemic and climate change. With COVID-19 being a novel disease and the pandemic unfolding at a very high speed, scientific results are bound to be preliminary and subject to a great amount of uncertainty. Epidemiological projections need to be constantly revised in the light of new developments and new evidence. Hence, policy advice can change significantly within short timespans. This is putting decisionmakers into a highly volatile and uncertain spot. Climate change research is much more mature, with multiple iterations of improving models in light of new evidence. Further, with the IPCC reports, there is a rigorous and consolidated scientific

process to evaluate the state of knowledge, which is approved by officials from each national government. Hence, the scientific consensus on climate change provides a comparatively clear and robust basis to inform climate policy.

The COVID-19 pandemic showcases the importance of defining a proper role for science in the future of climate policy making. While it is widely acknowledged that policy-making should be guided by robust scientific evidence, it needs to be understood that policy decisions can never directly be drawn from data itself or be "value-neutral" (c.f. Steele, 2012; Rudner, 1953; Douglas, 2009). Any goal setting in climate policy will require additional normative premises on how goods should be prioritised by society, and how the burden and costs of measures should be distributed. This leaves the "academic qua policy advisor" in the position of carefully weighing the role of impartially referring to the state of current research while being clear about arguing from specific normative points of view.[9]

Further, evidence-based strategies in science communication might be able to counter the politicization of climate science and inoculate citizens against fake news, for example by exposing misleading argumentation techniques (see Cook, Lewandowsky and Ecker, 2017; Bolson and Druckman, 2015; Oreskes and Conway, 2010; Côté and Darling, 2018). The current media focus on science and researchers might also be harnessed to have positive effects on the perception of the consequences of climate change among the public. Correcting the skewed picture of "static and certain science" and creating a better understanding about the scientific process among the citizenry may increase trust in science and help fight misinformation and conspiracy theories.

Conclusion

The COVID-19 pandemic and climate change both pose major systemic risks to human prosperity involving significant externalities. The various successes and failures of COVID-19 policy responses provide a chance for reflection on climate policy and progress. We compare the shared climate change and COVID-19 policy challenges of ensuring timely action, gaining public support for economic policy, addressing inequality, developing international cooperation, and clearly detailing the relationship between science and policy. We confirm important parallels for good policy design (see Figure 4): (i) delay is costly; (ii) effective policies must be designed so as to overcome psychological biases; (ii) policies must adequately address existing inequalities to prevent worse outcomes; (iv) wide international collaboration is essential; (v) scientific policy advice needs to transparently balance factualness with inherent value judgments. Despite those parallels, we find important reasons why climate change mitigation is a harder challenge for economic policy making: it requires profound and lasting transformations of the global economy. By contrast, most measures introduced to counter the pandemic, however deep they cut right now, can be lifted once the pandemic has ended. Vital economic transformations need to be implemented long before climate change

[9] One illustration for close collaboration between science and policy is the formulation of international mitigation objectives, such as the temperature goals in the Paris Agreement. The inclusion of the 1.5 degrees temperature goal in the Paris Agreement was seen as a success story for science-policy dialogue (Schleussner et al. 2016). The special report on the importance of limiting global warming to 1.5°C (IPCC, 2018) crucially influenced policy proposals in several countries including the European Green Deal (European Commission, 2019).

reaches catastrophic dimensions. Most of the burden of climate change damage will be borne by human beings in the future or in distant foreign locations, which makes it harder to build political priority.

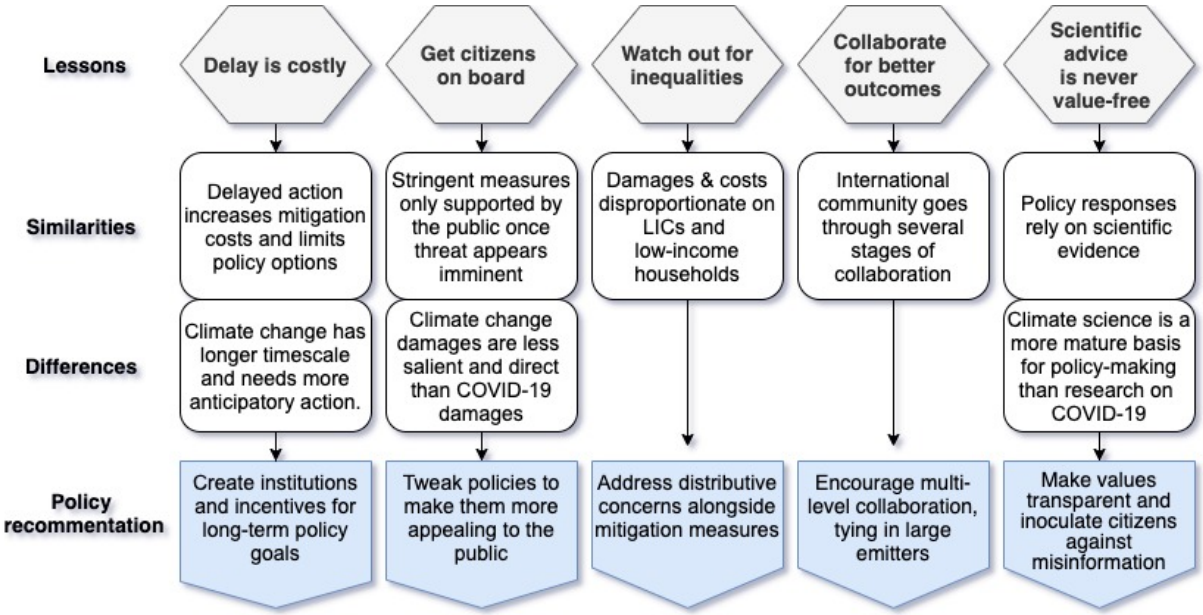

Figure 4: *Summary of similarities and differences between COVID-19 and climate change and policy lessons for climate change*

The lessons we draw in this article are sufficiently broad to be applied to a multitude of global commons problems that fit certain characteristics. These are: if inadequately addressed, damages and mitigation costs rise with time; mitigation policies have the potential to create losers; these problems tend to be highly politicised. As global COVID-19 case numbers continue to rise at the time of writing, our proposed lessons are to some extent preliminary and might not apply across all country contexts.

Current political action and restrictions on personal and economic liberties are unprecedented across most generations in Western countries. The global response to the COVID-19 pandemic is a precedential case that renders arguments against immediate climate investment less compelling. A coal phase-out or a rapidly increasing carbon price, as recommended by environmental economics, has been depicted in the past by many politicians as an intolerable burden to society for which there was not enough political will. After COVID-19, we believe that it will be difficult to discard economic arguments against climate policy in this way, as the economic costs of limiting climate change to below two degrees are projected to be orders of magnitude lower than those of COVID-19 containment measures.[10] This supports proposals for immediate green recovery stimulus. Additionally, it is imperative that

[10] Aiming for a CO_2 concentration of 450 ppm, which is compatible with limiting warming to below two degrees, would entail a reduction in the annual consumption growth rate of 0.06 percentage points (IPCC, 2014b, p. 15/16). The real reduction in the annual consumption growth rate might be well below this number, as these calculations neither account for immediate co-benefits nor for reduced climate change damages. Compared to the European Commission (2020a)'s projections of a contraction of 8% in GDP in the Euro area in 2020 due to COVID-19, the projected reduction in real annual consumption due to climate policy appears rather moderate, and is further spread out over much longer time horizons.

governance structures and institutions are bolstered in response to the pandemic, from the municipal to global level, and public perception is changed to increase the public support needed for long-term climate policies. Drawing the right lessons from this crisis will prepare policy-makers and citizens for the long-term challenges presented by climate change.

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