

Policy Paper

***Just & In-Time* Climate Policy**

Four Initiatives for a Fair
Transformation

9

Contents

Summary	3
Introduction: What is a <i>just & in-time</i> climate policy?	5
Background information from climate science	7
Realize a participatory and just decarbonization process early on: the coal phase-out as a crucial test	10
Challenges of <i>just & in-time</i> regional decarbonization	11
Learning from experience for upcoming tasks: proactive structural policy	12
<i>Just & in-time</i> implementation: a Zero Carbon Mission	13
Access to justice for people harmed by climate change	18
Global increase in the number of lawsuits relating to climate change	19
Barriers to effective legal remedies	19
Recommendations for effective access to justice	21
In Nansen's footsteps: a climate passport for humane migration	24
Climate-induced migration: a phenomenon of growing importance	25
The legal framework of climate-induced migration	26
The climate passport for <i>just & in-time</i> migration	28
Promote <i>just & in-time</i> structural change with transformation funds	31
Transformation funds as a tool for <i>just & in-time</i> transformation	31
Supporting structural adaptation processes in economically weaker countries	36

Summary

Limiting global warming to well below 2°C requires the rapid decarbonization of the global economy. If this enterprise fails, we will jeopardize the life-support systems of future generations. The longer the transformation towards climate compatibility is delayed, the more severe the risks and damage will be for a growing number of people. The transformation requirements and the damage caused by climate change have an unequal temporal, geographical and social distribution – as do the respective possibilities for dealing with them. The WBGU therefore proposes a *just & in-time* transformation that takes into account all people affected, empowers them, holds those responsible for climate change accountable, and creates both global and national prospects for the future. The WBGU proposes that the German Federal Government should promote four exemplary initiatives of a *just & in-time* climate policy targeting (1) the people affected by the structural change towards climate compatibility (e.g. in coal-mining regions), (2) the legal rights of people harmed by climate change, (3) the dignified migration of people who lose their native countries due to climate change, and (4) the creation of financing instruments for *just & in-time* transformation processes.

In order to meet the climate-protection goals agreed in Paris, global CO₂ emissions should peak in 2020 at the latest and be reduced to zero by about the middle of the century.

With a *just & in-time* transformation, the WBGU aims to combine *timely* decarbonization with *just* solutions for the people affected. This approach takes into account the demand for justice of (1) people who fear losses as a result of regional structural change due to the indispensable need for rapid decarbonization (e.g. employees in the coal industry: '*us now*'); (2) people who, at different places in the world, are already suffering today from climate-related loss and damage, e.g. through extreme weather events ('*people elsewhere*'); and (3) future generations whose life-support systems would be threatened by large-scale climate change ('*those after us*'). The approach of a *just & in-time* transformation aims to remove blockades of climate policy caused by the unequal temporal, geographical and social distribution of climate-related damage and transformation requirements. *Just & in-time* transformation combines a timely transition that avoids tipping points in the climate system with a just transition that allows both socially acceptable de-

carbonization and a just way of dealing with current and future loss and damage by holding those responsible for climate change to account.

In the following, the WBGU presents four exemplary initiatives for a *just & in-time* climate policy aimed at empowering the people affected.

Decarbonization must be timely and participatory

Decarbonization requires rapid and proactive structural change involving considerable challenges for regions and sectors hitherto dominated by fossil energy carriers. The coal-mining regions are a prime example of this. An early, transparent and participatory approach to find a common understanding (1) on the potential 'winners' and 'losers' of the unavoidable phasing-out of coal, and (2) on future-oriented options for alternative regional identities and development models offers the best answers to these challenges and prevents delays and distortions. The WBGU therefore recommends launching a 'Zero Carbon Mission' as an initiative for a *just & in-time* transformation. Its purpose would be to professionally accompany and financially support regional structural change in order to enable globally responsible

action, reduce social risks to the people affected, create networks between the regions, and strengthen their future-directed orientation and capabilities to engage. A constructive attitude towards new economic prospects for the future can help overcome a fear of loss, feelings of insecurity and lock-ins.

Legal remedies for people harmed by climate change

Companies that contribute to climate change through emissions (e.g. operators of coal-fired power plants) can legally assert claims for damages if they are forced by state authorities to close their plants. Yet the legal rights of the (often poor) people affected by massive climate damage vis-à-vis the large companies that contribute to climate change are uncertain. In the WBGU's view, this asymmetry stands in the way of a *just & in-time* transformation. People affected by existence-threatening, climate-related loss and damage should similarly be able to seek redress in court – also to establish, in the long run, mechanisms for equitable compensation. Challenges here include establishing causal links that will stand up in court between specific emissions and climate-related loss and damage, the risk of litigation costs, and filing lawsuits in time. The WBGU recommends that, within the framework of development cooperation, Germany's Federal Government should assume the litigation cost risks for some promising pioneer lawsuits brought by particularly vulnerable people and communities, in order to provide them with timely legal protection. The Federal Government should also use its influence internationally to ensure that the people threatened by considerable climate damage are given effective opportunities to take legal action across national borders.

A climate passport for people who lose their homes due to climate change

Climate change is already seen as a driver of migration and could trigger large-scale migration movements in the three-digit million range by the middle of the century. Up to now, these people have only been provided with inadequate protection and support. In contrast to a centrally controlled or authoritarian approach, the WBGU calls for a liberal-humanist way of dealing with migration that respects the dignity of the individual. The WBGU proposes a climate passport for migrants as an international instrument of a *just & in-time* climate policy. It is based on the model of the Nansen passport for stateless persons, which enabled hundreds of thousands of people to find refuge after the First World War. First, it should grant residents of low-lying island states particularly threat-

ened by climate change access and rights equivalent to citizens' rights in safe countries. In future, it should also provide early, voluntary and dignified migration for citizens of other states who are massively affected by climate change and for similarly affected internally displaced persons. Countries with high levels of emissions and thus considerable responsibility for climate change should make themselves available as host countries according to the 'polluter pays' principle. The WBGU recommends that the German Federal Government should advocate the introduction of the climate passport at the Climate Change Conference in Katowice and promote interdisciplinary research on climate-induced migration.

Transformation fund for equitable structural change

To ensure that the necessary structural change towards a decarbonized world economy is *just & in-time*, sustainability criteria should be consistently taken into account in financial flows and investment decisions; interdisciplinary research should be conducted on the associated challenges. The WBGU recommends that both the German Federal Government and the governments of other countries should set up state funds for *just & in-time* structural change towards climate compatibility as an important step in this direction. The transformation funds should accelerate the implementation of the climate and sustainability goals via investments and holdings in key industries. The returns should be used for the participatory design of *just & in-time* structural-change processes. The volume of the transformation funds should be built up by pricing greenhouse-gas emissions, supplemented by revenue from a reformed inheritance or estate tax. The transformation funds achieve a triple control effect by gearing the collection of funds, the investment strategy and the use of returns towards the requirements of a *just & in-time* transformation. Furthermore, the WBGU recommends providing support for economically weaker countries to build up their own transformation funds and tackle structural change via a facility at the World Bank or regional development banks.

Introduction: What is a *just & in-time* climate policy?

Policy-making should – indeed must – be just. This applies – by its very nature – particularly to climate policy. But *who* grants or guarantees justice to *whom* and on *what* codified *basis*? Conventional reasoning on law and justice is largely at a loss here, because, in the case of the climate problem, the ‘who’ and the ‘whom’ may be separated by centuries; certainly by entire oceans. And from ‘what basis’ in international law can one argue and institutionalize when the challenge is as unique as the urgent need to preserve creation?

The Paris Agreement of 2015 aims to address this challenge. Its implementation rules are to be negotiated at the Climate Change Conference in Katowice in December 2018 (COP24). In terms of climate physics, global warming can only be slowed to ‘well below 2°C’ if the world economy is almost entirely decarbonized *before the middle of the century*. In terms of social psychology, however, this can only succeed if global CO₂ emissions reach their peak *around the year 2020*. Should this deadline be missed, the transformation processes required *later* would probably be too drastic to be acceptable in large parts of world society. However, if we fail to reach the Paris goals, a number of tipping points in the climate system are likely to be exceeded, with the consequence that large-scale and mostly *irreversible* damage will be done to the natural life-support systems of future generations.

This briefest possible characterization of the climate-policy challenge shows very clearly that everything revolves around taking action in time. This timeliness is inseparably linked with the entitlement to justice over time: only if the ‘dictatorship of now’ does not prevail yet again can a solution to the climate problem be found that is worthy of the name. Because, in the river of time, some people live ‘upstream’ and others ‘downstream’ – what we do today may have a grave impact on billions of people in future generations, yet they can do nothing to retroactively hold us to account! This is a fundamental *causal asymmetry* with serious ethical consequences.

In line with numerous studies, the WBGU begins by stating that a ‘Great Transformation’ towards climate neutrality is technologically possible and financially feasible. Yet progress is slow in Germany, Europe and worldwide. This is due not least to the fact that the con-

cept of justice is distorted, even abused, in the context of decarbonization. In particular, the narrative on a ‘just transition’ creates confusion here and is used deliberately by some actors in the climate-policy field to create a moral imbalance.

It is undisputed that the structural change needed for an effective mitigation of climate change poses great challenges for people, regions and entire societies. It is also undisputed that societal legitimacy for the necessary transformation processes can only develop if these processes are handled in a socially acceptable way. The topic of a just transition was therefore placed prominently on the agenda at the Petersberg Climate Dialogue in the summer of 2018, which was organized by the Polish and German governments in preparation for the Climate Change Conference in Katowice. Because the use of coal is especially harmful to the climate and health, certain regions (such as Upper Silesia and the Lausitz) must soon develop a new, more sustainable business model. This is also the topic of the ‘Commission on Growth, Structural Change and Employment’ set up by the German Federal Government. The main task of the Commission is to submit – by the start of the COP24 in Poland – a socially acceptable timetable for phasing out the use of coal-fired electricity generation in Germany. The focus on acceptance reflects the insight that decarbonization can only succeed if it is carried out in a just manner and if prospects for the future are developed for the people and regions affected by structural change.

It is furthermore undisputed that whoever speaks of the interests of those who suffer economically and socially as a result of climate-mitigation policies should also mention those who suffer as a result of a *failure to mitigate climate change*. They already exist today: the poorest of the populations in vulnerable countries and regions where melting glaciers, rising sea levels and increasingly common extreme weather events are making everyday life more and more difficult. If global warming proceeds unabated, the very territorial existence of certain countries will be at stake. Under these circumstances, migration becomes a survival reflex, if the people can still muster the necessary energy. However, the weakest people affected by climate change are those who are *not yet born*, i.e. future generations who

cannot intervene in the current conflict of interests – either through democratic voting rights and consumer decisions or in the form of civil resistance. Nor can they organize demonstrations like miners are currently doing – quite legitimately – in certain coal-mining areas.

However, in some cases, political pressure is exerted not only in favour of a just decarbonization; some actors ignore the fact that a substantial proportion of the prosperity of the emissions-intensive sectors, regions and entire economies was accumulated over many decades by using the Earth's atmosphere as a free waste-disposal site. The horrendous externalities (including the possible destabilization of the entire climate system) of the gratuitous disposal of industrially produced greenhouse gases often go unmentioned. Instead, demands are sometimes even heard for *the legitimization of continued benefits*. For example, the rich countries are highly reluctant to talk about even moderate compensation for historical or future climate-related damage (see the debate on loss and damage in the UN Framework Convention on Climate Change). So who is threatened with injustice as a result of climate policy? Saudi Arabia or Tuvalu?

A just climate policy that aims to create national and international legitimacy for the implementation of the Paris Agreement must therefore prevent a situation in which fear of loss and harm suffered by people and groups affected today and in the future, in different ways and in different places on our planet, are played off against each other. Against this background and in light of the considerations presented above, the WBGU proposes the concept of a *just & in-time* transformation. This concept combines local, national, global and intergenerational claims for justice with common-good perspectives – and counts on a culture of global cooperation. This is ultimately the only way to solve the great conflicts of interest and blockages in climate politics.

The social innovation of a *just & in-time* transformation addresses a fundamental dilemma that might ruin attempts to preserve our planetary civilization. The justice discussion outlined here involves enormous tensions between the demands of '*us now*' (from a European perspective e.g. those affected by structural change towards climate compatibility in corresponding sectors and regions), '*people elsewhere*' (e.g. in the Sahel region, who are largely helpless in the face of progressing desertification), and '*those after us*' (i.e. future generations who will be harmed by a refusal to take action to mitigate climate change today). The automatisms of politics often lead to measures that focus on '*us now*', pay less attention to the legitimate interests of '*people elsewhere*', and not infrequently postpone responsible action at the expense of '*those after us*'.

In the face of internationally interconnected problems like climate change, these automatisms, which

many nationalist movements and governments are currently taking to extremes ('Our Country First'), lead to international tensions and conflicts, block concerted action, and ultimately lead to irresponsible policies. The concept of a *just & in-time* transformation, which appropriately takes into account the rights of all people affected by climate change can help overcome these social and political dilemmas. It means thinking through the shift in perspective towards a globally networked world society that is laid out in the Paris Agreement. Peace and prosperity can only be secured through joint action oriented towards international fairness.

In the following chapters, the WBGU introduces four initiatives with great symbolic power that show how a *just & in-time* climate policy can be moved forward. They can be summarized in the following recommendations:

1. Provide early and professional support for participatory and socially balanced structural change in transformation regions and sectors (*Zero Carbon Mission*);
2. Support those who have already suffered massive loss and damage due to climate change in finding legal clarity on possible compensation entitlements (*climate lawsuits*);
3. Create humane and dignified migration options for people who lose their native countries due to climate change (*climate passport*);
4. Establish financing instruments that close financing gaps and embed the requirements of a *just & in-time* transformation in their collection of funds, their investment strategy and their use of returns (*transformation fund*).

Background information from climate science

The fossil-fuel-based industrialization of the world economy has already increased the concentration of CO₂ in the atmosphere by about 45%. Before the beginning of industrialization, the level was 280 ppm (Neftel et al., 1985); 2016 was the first year in which the concentration remained consistently above 400 ppm.

The resultant global warming is advancing in line with expectations. 2017 was one of the three warmest years since temperature records began; global warming on land and in the ocean was 1.1 (±0.1)°C compared to pre-industrial times (1850–1900). The other two warmest years, 2015 and 2016, were greatly influenced by the El Niño phenomenon, which causes episodic increases in the Earth's average temperature (WMO, 2018). 2016 was the warmest year ever to date. It owes its record mainly to man-made climate change and only to a lesser extent to natural variability (Knutson et al., 2018).

In order to limit further warming as a result of human activities, it is necessary to stop the input of CO₂ into the atmosphere. The decarbonization of the global economy has become urgent. In order to achieve the goals for climate-change mitigation adopted in Paris in 2015, global CO₂ emissions should peak no later than 2020. Subsequently, they should steadily decline (Rogelj et al., 2015; Figueres et al., 2017). Indeed, global CO₂ emissions between 2014 and 2016 were already nearly constant, but increased significantly again in 2017 (Le Quéré et al., 2018).

Recommendation

Through global decarbonization, the peak of global CO₂ emissions should be reached by 2020 at the latest

A delay in the reduction of emissions would initially require even faster and therefore more difficult reductions in order to limit global warming to well below 2°C (Figure 1). If the delay continues, this will ultimately undermine the chances of reaching the goals agreed in Paris at all (Figueres et al., 2017).

On the other hand, the faster emissions are reduced, the less need there will be to rely on the speculative future use of technologies for removing CO₂ from the atmosphere to reach the climate goals (van Vuuren et al., 2018). Furthermore, a fast reduction of CO₂ emissions from the use of fossil fuels also means a reduction in air pollution and could prevent many millions of premature deaths worldwide (Shindell et al., 2018). This positive effect would not occur if current emissions were compensated later by the extraction of CO₂ from the atmosphere.

The level of global warming observed up to now is already causing serious changes which directly affect people's living conditions. In a 2°C world, too, the poorest population groups in particular, who have benefited least from the advantages of modernity, are the most seriously affected (King and Harrington, 2018).

Extreme weather events are one example of the harmful effects. From a global perspective, the strength and frequency of such events has increased in recent decades (Herring et al., 2018). Heat records are broken five times more frequently than if there were no climate change (Coumou et al., 2013); similarly, the extreme heat in Asia in 2016 would not have been possible without it (Imada et al., 2018). In addition, the strength of tropical cyclones is expected to increase further with the warming process – both on average and in terms of the number of storms in the top category (Sobel et al., 2016).

Furthermore, the rise in global sea levels has accelerated further as a result of global warming (Chen et al., 2017; Nerem et al., 2018) and will decisively influence the living conditions of millions of people in the coming decades and centuries (IPCC, 2014).

The melting of the Antarctic ice sheet alone could add over a metre to sea-level rise by 2100 and over 15 metres by 2500 (DeConto and Pollard, 2016). The highest figures are to be expected in the tropics, where,

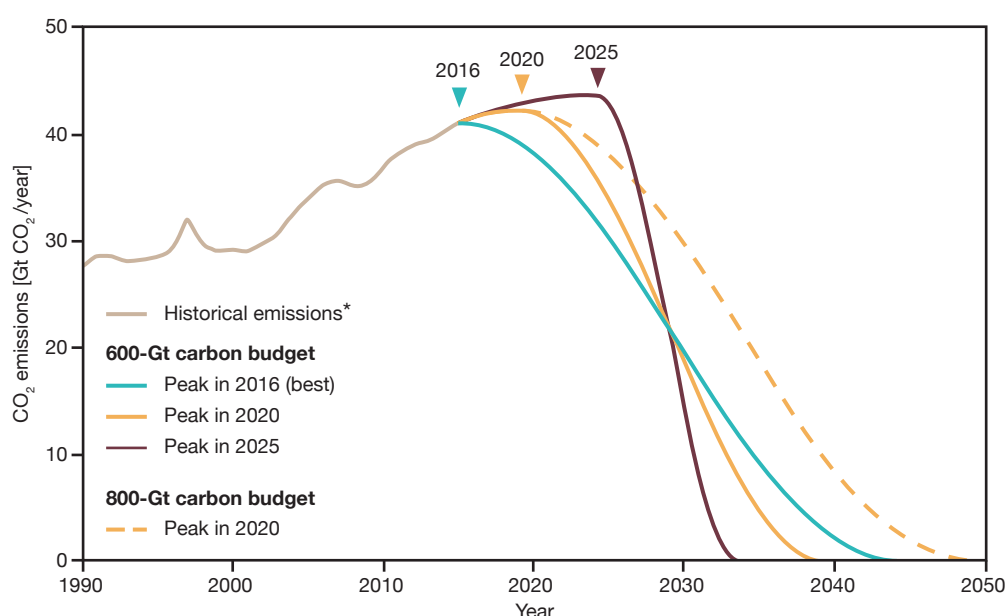


Figure 1

Relationship between the peak in global CO₂ emissions and the necessary speed of transformation. The scale of climate change depends on the cumulative CO₂ emissions, so the later emissions peak, the faster they must subsequently be reduced in order to achieve a specific climate goal. Taking the case of limiting climate change to 1.5–2°C, the chart uses the example of a mean emission budget of 600 Gt CO₂ to show the effect of a shift in the peak on the required transformation speed. A larger budget of 800 Gt CO₂ would lengthen the period within which the emissions must fall to zero by about 10 years, but involves a greater risk of missing the climate goals. Source: based on Figueres et al., 2017; *data from the Global Carbon Project

under a business-as-usual scenario, increased flooding could make many atolls uninhabitable as early as the middle of the 21st century (Storlazzi et al., 2018). In view of the considerable uncertainties involved, protective measures should be based on the highest recent projections. High short-term costs would be justified in this context, because “ignoring such estimates could prove disastrous” (Oppenheimer and Alley, 2016). Apart from the costs, time is also of decisive importance. Each five-year delay in the global emissions peak could lead to a further 20 cm rise in sea levels by 2300 (Mengel et al., 2018).

Such extremes and changes, which also affect rainfall and vegetation patterns, not only cause considerable economic damage (Stern, 2006), but also pose great challenges for many people through increasing pressure to adapt, as well as through loss and damage. They adversely affect food production, health and the working conditions of many people (IPCC, 2014). Understanding these relations between individual loss and damage and climate change amounts to a new challenge for science (Box 4).

Irrespective of difficulties in proving causal relationships, living conditions in individual regions can deteriorate to such an extent that people feel forced to leave their homes (Vinke et al., 2017). Although it is dif-

ficult enough to define a migration decision induced by climate change – and figures in the literature therefore differ widely (Adger et al., 2014) – an estimate made by the World Bank on internal migration is mentioned here as an example. By 2050, more than 143 million people in sub-Saharan Africa, South Asia and Latin America could be forced to leave their homes due to climate change (Rigaud et al., 2018).

Consequently, fast and global decarbonization is necessary, as outlined e.g. by Rockström et al. (2017) on the basis of halving emissions in each successive decade (Figure 2). Furthermore, the climate-change-induced loss and damage that has already occurred must also be taken into account. Both of these aspects affect the well-being and dignity of billions of people. It is important to empower the people affected to deal with the climatic threats and structural changes in a self-determined, *just & in-time* way.

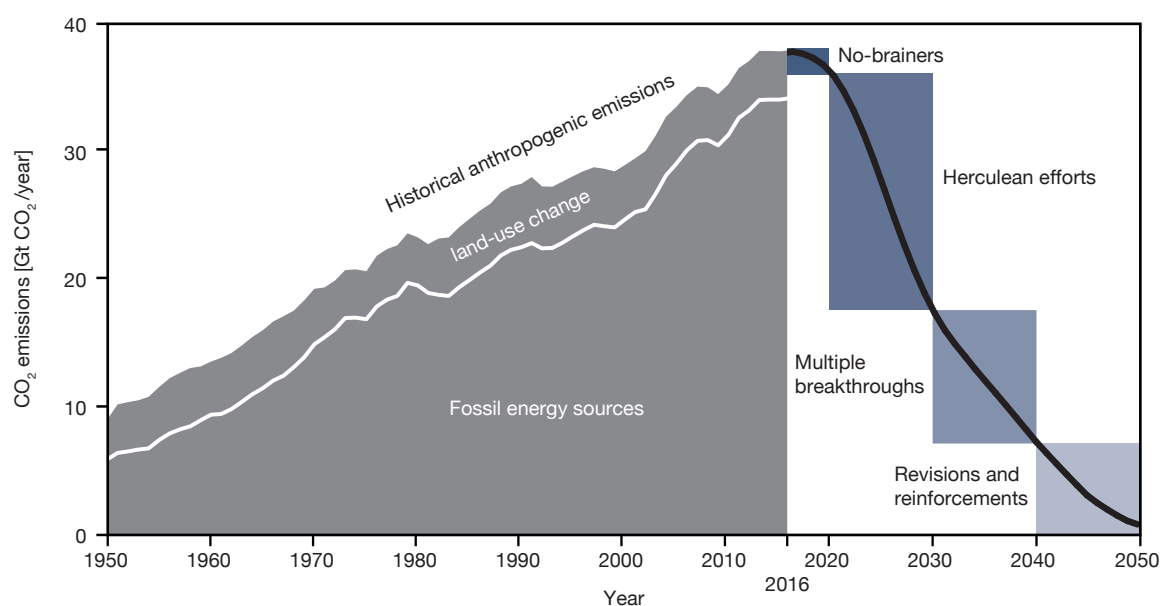


Figure 2

Carbon roadmap for stepwise decadal decarbonization. The chart shows an exemplary development of emissions, which could be achieved, among other things, by an extensive coal phase-out by 2030 and a complete conversion of the energy system to renewable energies by 2050 (WBGU, 2016a). The blue squares indicate decadal steps to be taken by 2020, 2030, 2040 and 2050, which should result in decarbonization by the middle of the century. The steps are explained in WBGU (2016a).

Source: WBGU, 2016a

Realize a participatory and just decarbonization process early on: the coal phase-out as a crucial test

The aim of decarbonizing the world economy by the middle of the 21st century is a must for curbing climate change. Decarbonization must be initiated and organized politically – e.g. through targeted pricing of greenhouse-gas emissions, policies of innovation funding, and support for regional and sectoral structural change. Coal is the most greenhouse-gas-intensive energy carrier and also has significant environmental and health impacts (WBGU, 2011). In concert with other measures to mitigate climate change, the coal phase-out should be largely completed worldwide by 2030 (Rockström et al., 2017). Certain nations and regions will be particularly affected by the upcoming transformation. They could learn from previous structural-change processes in their efforts to accomplish this task. For decades, many regions in Europe have experienced a decline in mining or the migration of large companies in various industries, so that valuable experience in cushioning disruptive regional structural change has already been gained.

However, specific conditions apply to the phasing out of coal as a step towards decarbonization. A *just & in-time* transformation must be achieved within the short time periods mentioned above, since the climate objectives adopted in Paris will otherwise not be met. In contrast to the usual dynamics of structural change in market economies, decarbonization will not be forced by the market. It is a political objective based on an understanding of the destructive effects of dangerous climate change. The structural change towards a low-carbon society needed in Germany, Europe and elsewhere is therefore important not only for economic modernization in the affected regions, but also to discharge a global responsibility: to limit climate-related loss, damage and risks worldwide.

Large-scale transformations of economic structures like the energy system involve great societal changes (comparable with, for example, the industrial revolution). Not only value chains, business and labour models are re-aligned, but also conceptions of progress, actor constellations and regional identities. Transformations

are therefore highly political; questions about the future and justice take centre stage. Accordingly, in the current discourse on climate-change mitigation and a ‘just transition’ there is a call for the direct participation of employees in the winding-up of coal-mining companies, accompanied by the wish to be assured attractive jobs after coal has been phased out. The term ‘just transition’ was established in the 1990s by trade unions formulating the demand to safeguard employees against the effects of environmental policies. Today, the International Labour Organization (ILO) and the International Trade Union Confederation (ITUC) themselves back the demand for structural change towards a sustainable economy, describing it as a collective task of renewal for regional communities (ITUC-CSI, 2017:3). Often, however, the term ‘just transition’ is linked with the argument that processes such as the coal phase-out must be slowed down in order for them to be fair.

The challenge, therefore, is to shape political processes in a way that enables a regionally fair and sufficiently fast process of decarbonization in order to avoid global and irreversible damage from dangerous climate change. *Just & in-time* structural change is necessary. Although future economic and labour-market structures cannot be planned in detail in the context of structural change, essential components of the transformation towards a low-carbon society should be social guard rails such as inclusion, alleviation of social repercussions, support for those affected by structural change, and an inclusive process for shaping the future. In the WBGU’s view, therefore, just transformation policy is defined not (only) by the duration, but by the quality and social design of the transformation processes. People should be at the centre of structural change, so that affected people can become active participants. This means not only that a supportive, reliable political framework and adequate resources must be provided, but also that all those affected must be effectively empowered to participate critically and constructively.

In this sense, the WBGU proposes the launch of an

overarching ‘Zero Carbon Mission’ on multiple political levels. Its aim should be to strengthen and interconnect transformative potential in the affected regions on the basis of reliable local, national and international frameworks. The Zero Carbon Mission should enable future-oriented modernization strategies for ‘pioneer sustainability regions’ and not be limited to immediate crisis management. International networks of these transformation regions could create not only common learning processes, but also a greater awareness of the necessity to take rapid action based on a global responsibility for today’s and future victims of dangerous climate change. The intention is for proactive regional transformation initiatives to emerge and be encouraged within this framework. They should receive professional support in designing processes to increase the equity and quality of participation. Furthermore, as many as possible of those affected should be offered educational or training schemes, and alternative employment options should be promoted. Parallel to this, the WBGU recommends an increase in funding for research on the factors that drive successful transformations.

Challenges of just & in-time regional decarbonization

Large-scale transformations of economic structures have profound effects on people’s lives. This was the case during the transition to the age of fossil fuels, and it will also be the case in the transition to the post-fossil fuel age. Fundamental questions about our future and justice take centre stage. Transformative change demands a lot of proactive effort; otherwise changes are postponed or blocked.

Achieving a just distribution of decarbonization’s benefits, burdens and compensation claims is a key socio-political question that has no easy solutions. A swift phase-out of coal-based power generation and the associated, often regionally concentrated coal mining helps combat climate change and reduces medium- to long-term climate-related loss and damage worldwide. However, this also has negative direct or indirect effects on a range of different actors in the short term: on companies and their suppliers; employees and their families; trade-union interest groups (ITUC, 2015; ITUC-CSI, 2017; Ryder, 2014); sectors of the regional economy that are dependent on local purchasing power; municipalities with an interest in tax revenue; political leaders under pressure to justify their policies; and, last but not least, the local population, who are also involved in this transformation of economic structures.

Structural-change processes in mature industrial regions are typically characterized by path dependencies

and lock-in effects that lead to delays and blockades. Not infrequently, structural change has been held back by affected companies, employees or politicians (Hassink, 2010). Established business models and the interests of influential regional actors often hinder economic transformation and inhibit the evolution of alternative development pathways. Barriers emerge in the form of functional lock-ins (caused by hierarchical, rigid corporate or supplier networks), political lock-ins (as a result of close alliances between public and private actors), or cognitive-cultural lock-ins (generated by the conservative force of world views shared by many stakeholders; Grabher, 1993). Another factor is the inhibitory effects of short election cycles, which encourage political decision-makers to pay more attention to certain voter groups (*‘we now’*).

Key lock-in factors of a coal phase-out have already been scientifically identified; they vary according to the regional, historical and political situation (Steckel and Jacob, 2018). For example, the coal industry often has great regional economic importance, i.e. the economy and administration depend on its profits, jobs and taxes. In developing countries like Indonesia, the coal industry is also very significant as an export sector or as a guarantor of foreign-exchange earnings. The coal sector can dominate the energy supply and infrastructure and keep political elites in power in politically fragile countries (Ganswindt et al., 2013). Furthermore, coal plays a culturally significant role in national and regional identities, as shown by the German economic miracle of the 1950s, which was largely coal-based (Heinze et al., 2013).

In order to dismantle such blockades in the case of the imminent coal phase-out, a different approach to fair burden-sharing is needed than in previous cases of structural change in the coal-mining regions of western and central Europe. While restructuring processes were then driven mainly by losses of international competitiveness, and politics often did little more than react (Hassink, 2010), purposive decarbonization requires forward-looking, early, proactive intervention by the state in alliance with other actors. Climate-change mitigation is an internationally consensual political objective and national task that definitely justifies taking action to close coal-fired power plants and abandon coal mining as soon as possible. At the same time, such state interventions in entrepreneurial freedom are subject to increased public and political justification pressure, even though competition in markets – e.g. leading to company closures – can trigger an equally strong effect.

Although the regional structural change required for global climate-change mitigation generates some losers, it definitely generates winners, too. The WBGU has described the chances of a transformation towards

Box 1**Identity and a sense of belonging as prerequisites for dealing with disruptive structural change**

Shaping structural change requires supporting the individuals affected in dealing with change in the best ways possible. Fundamental changes in people's living conditions – such as leaving their home or having to quit a job held for many years – can be seen a life crisis for those affected (Huffman et al., 2015; Paul and Moser, 2009; Paul et al., 2014). The psychological stress they experience considerably restricts their quality of life, sometimes leading to chronic stress and demoralization (Hobfoll, 1989; Lazarus, 1993).

In regions where coal is to be phased out, those affected lose not only *financial resources*, i.e. their income, but also *social resources* such as their circle of colleagues and their social status. Furthermore, many are also forced into early retirement and have to make major changes to their everyday lives. The immediate and future monetary loss generates stress (Hobfoll, 1989), for example if the value of a person's home threatens to decline as a result of regional change. These losses affect not only the employees but all citizens throughout the region. Financial and, above all, social resources are an integral part of one's own identity, which is why a (threatening) loss of resources is experienced as a psychologically harmful loss of identity (Breakwell, 1986; Hobfoll et al., 1990; Jahoda, 1982).

These resources of stakeholders should be taken into account and strengthened during processes of structural change. Apart from financial compensation schemes, social networks and social capital are key for crisis management; they integrate friends, family and other socio-political actors (Aldrich and Meyer, 2015; Huffman et al., 2015). Another important personal resource is experiencing self-efficacy, i.e. the positive experience of having control and creative leeway (Bandura, 1977). In addition to social security mechanisms, subjective experiences of freedom and opportunities to participate in shaping one's environment are, therefore, crucial for successful stress management (participation opportunities).

Systematic support for the individual and for social networks is therefore decisive when it comes to ensuring that the people affected can actively cope with this life crisis. For

this reason, participatory processes are essential. Joint involvement in forums to decide on the future promotes a collective identity and self-efficacy in one's own actions (Bamberg et al., 2015). The WBGU is convinced that, on principle, the participation of civil-society stakeholders has a key role to play in finding solutions to environmental problems (WBGU, 2011).

Participation as a prerequisite of successful regional transformation processes

The systematic development of participation techniques (e.g. Horelli, 2002) and a stable support framework (Renn et al., 2011; Renn and Webler, 1998) are key prerequisites for successful participatory processes.

One element is *professional process management*, for example through independent mediators. Complex challenges like the coal phase-out also require sophisticated participation procedures (Matthies and Blöbaum, 2008) to accompany the process of structural change – from initiation via planning and implementation to evaluation (Horelli, 2002). It is important to *involve the parties as early as possible according to transparent rules* and to avoid all risk of excluding certain groups from the process, e.g. socially vulnerable sections of the population (Alcántara et al., 2014). Even the choice of information channels used to send out invitations, or financial and time restrictions, can affect who will get involved. Checks should also be made on whether all affected stakeholders are being included (Baasch and Blöbaum, 2017). Furthermore, a sufficient *financial framework* is important for the success of the participation process (Renn et al., 2011), e.g. involving financial compensation for the participants' loss of work.

Procedures like the 'planning cell' (Dienel, 2002, 2009) offer recommendable components of participatory processes with citizens. Participants are selected on a representative, random basis and supported by being released from work. Inequalities between experts and citizens and the need to strengthen minorities are taken into account by compensatory measures, e.g. process officers (who make sure that 'the weak' also participate), and by making highly technical subjects understandable to non-experts. The results are recorded in a citizens' report and, in some cases, implemented in agreements that are binding for decision-makers (Alcántara et al., 2014).

sustainability in a special report. The transformation inspires innovations, directs investments towards sustainability and climate-change mitigation – e.g. towards the sustainable infrastructures that need to be installed and developed – and it can be used to combat inequality, i.e. to advance inclusion (WBGU, 2016a). Potential regional structural improvements through decarbonization can be generated, for example, by more environmental and health protection, enhanced regional development prospects or new jobs. However, people's negative feelings about current and anticipated losses often tend to outweigh their positive anticipation of future benefits. And short-term, large-scale losses are regarded as more threatening than relatively small losses spread over a longer period – even if, at the end of the day, the latter turn out to be much higher (Tversky and Kahneman, 1981; Weber, 2006). Taking into account the political pressure to justify transformations towards sustain-

ability and the fear of loss it triggers in the population (Box 1), it is important to turn those affected by the coal phase-out as quickly as possible into key advocates of the abandonment of the regional coal economy.

Learning from experience for upcoming tasks: proactive structural policy

Many countries in Europe, particularly the UK, France, Belgium, the Netherlands, Germany and, most recently, Poland, already know what is needed during a major regional structural change when coal mining is in decline; lessons can be learned from this for future decarbonization (Campbell and Coenen, 2017). For example, delayed restructuring processes without a clear political vision from the outset increase not only economic costs, but also social and psychological costs, e.g. through lost

confidence and fear of the future (Schulz and Schwartzkopff, 2017; Box 1). For example, the coal-based mining and steel industries of the Ruhr area initially did not recognize – or largely ignored – indications of the approaching structural change. Progress – e.g. establishing new companies – was deliberately made more difficult by those politicians and businesspeople who did not want to bring competing employers into the region (Goch, 2002; Grabher, 1993; Hassink, 2010). Later, much bigger efforts needed to be undertaken in the coal-mining regions, including compensation payments to previous employees and the cost of building up new industries and service sectors.

From the late 1950s to late 1990s, nearly 430,000 lost jobs had to be compensated in the Ruhr coal-mining industry alone, plus another 70,000 or more in the iron and steel producing industry. Taking into account indirect employment effects, almost two million jobs were lost in the manufacturing sector in the whole of North Rhine-Westphalia (Goch, 2002). The cost of the diverse measures taken over decades to promote structural change cannot be properly quantified, but it certainly adds up to several hundred billion euros. Compared to such dimensions, the structural policies for the imminent coal phase-out seem quite affordable, even though the structural change will have to take place much more quickly to achieve timely decarbonization. Poland currently has the most coal employees in the EU (in 2015 approx. 90,000 in hard coal; 10,000 in lignite), followed by Germany (approx. 10,000 in hard coal, mining of which is due to end in 2018; approx. 15,000 in lignite; EURACOAL, 2017:11). In Germany's largest lignite-mining areas of Rhineland and Lausitz, nearly 10,000 employees work in opencast mining and power plants (Statistik der Kohlenwirtschaft, 2017a, b). Also, indirect jobs with suppliers and companies depend on cheap power. A transition with the help of intelligent approaches that can be quickly implemented seems feasible even in such economically vulnerable regions as the Lausitz.

Experience gained in successful restructuring projects can be used for tackling the imminent challenges. These relate to repairing environmental damage (e.g. the renaturation of rivers, remediation of contaminated corporate land in the Ruhr area, and its transformation into new leisure, tourism and cultural attractions close to cities; WBGU, 2016b), building new universities and expanding existing ones, comprehensive training schemes, and setting up numerous technology and start-up centres (Fromhold-Eisebith, 2012). In places where a change of identity succeeds with the help of regional initiative (e.g. by developing skills in the creative industries), the threat of a loss of social cohesion can be contained. The experience and knowledge

of proactive structural-policy projects that is available in many regions, especially in North Rhine-Westphalia (Goch, 2002; Heinze et al., 2013), can also be used in an international context. In some cases, regions soon to be affected by decarbonization are already active. For example, the 'Rhineland Innovation Region' ('Innovationsregion Rheinisches Revier') is already shaping the future of the large affected area for the period after the planned phasing out of lignite – using participatory formats to encourage new actor coalitions and innovation projects. Established regional development concepts provide important orientation marks in this context (Box 2).

General lessons for *just & in-time* decarbonization processes can be learned from Germany's difficulties with a coal phase-out: the earlier and more predictably the change processes are initiated and pursued by experts, the lower the long-term economic and social costs are likely to be. If planning for the necessary transition begins at an early stage, ill-prepared, rushed measures can be avoided, broader regional areas of action can be explored and lock-in barriers rapidly identified and broken down. Of course, regional measures to compensate for disruptive structural change need time because they cannot be implemented 'top-down' using methods of political control; for example, business start-ups and relocations are ultimately market-driven. Similarly, building up new infrastructures beyond coal-fired electricity generation cannot be planned and implemented overnight. However, favourable conditions for the transformations can be established within a few years. In addition to experience and knowledge from previous periods of structural change, the now-urgent task of decarbonization trains the spotlight on questions of justice. An early, proactively initiated structural change driven by a clear vision seems a just solution for regional stakeholders because it offers more planning security, political influence and economic compensation options than long-delayed restructuring processes. It also provides a better basis for handling people's emotional and social concerns. It is most certainly just for those affected by climate change, especially with regards to the justified claims of future generations.

Just & in-time implementation: a Zero Carbon Mission to decarbonize regions

In order to shape the politics of a *just & in-time* coal phase-out in a proactive way, the WBGU recommends a polycentric assumption of responsibility in support of the Paris Agreement's global decarbonization goal. A strong political commitment on different levels (regional, national, supranational, international) is

Box 2**Use regional development plans for structural change towards decarbonization**

In order to deal in a *just & in-time* way with regional structural upheavals caused by phasing out coal or by decarbonization, it is possible to use established concepts of regional development that have long functioned as guidelines of economic structural change. These are (1) usually already established among key actors and can thus be applied relatively quickly, (2) oriented towards constructive interaction between different geographical and administrative levels, as is appropriate for the global task of decarbonization, and (3) geared towards participation through the involvement of the regional actor groups, which promotes justice.

As regards the advantages of using established approaches (1), measures of regional structural funding at the international level have long-since been oriented towards such models as 'Cluster', 'Learning Region' or 'Regional Innovation System' (Koschatzky, 2018; Moulaert and Sekia, 2003). They emphasize the need to synergetically network and recombine local actors from the business and science community; this makes it possible to link up with them directly to make positive joint use of the coal phase-out for an innovation-based transition.

Furthermore, particularly the 'related variety' propagated at the EU level (Asheim et al., 2011) can promote a relatively rapid transition away from the coal economy. In this context, on the one hand the benefits of relatedness must be taken up by using existing strengths (e.g. operational skills, human capital, R&D capacity). This can accelerate processes because, to some extent at least, it is possible to build on something given; it also preserves aspects of regional identity, thus restricting lock-in-barriers. On the other hand, variety aims to change the regional development pathway in an evolutionary manner in the direction of new industrial, corporate and innovation trends.

Requirements of cross-scale networking (2) and regional participation (3) are conceptually already established in the guiding concept of 'smart specialization' propagated at EU level (Foray, 2014; Morgan, 2017). In this case, the EU largely lays down the overall framework and requires certain strategy processes, which then have to be implemented nationally and regionally. The approach explicitly calls for a participatory procedure at the regional level: in the course of an entrepreneurial discovery process, which, as a bottom-up approach, incorporates various local actors, regions should identify their change potential themselves and proactively leverage its value for innovation-oriented strategies (RIS3 Process; European Commission, 2012).

essential in order to join forces and send out strong, concerted stimuli to boost developments towards a coal phase-out. The WBGU recommends initiating a Zero Carbon Mission in the sense of a campaign that initially drives the coal phase-out, but should ultimately also extend its reach beyond the coal sector to achieve decarbonization. The EU and its Member States have an obligation here and should take the lead. Embedded in and supported by a funding framework at the European and national levels, the main initiative for the structural change should be started locally by the regions themselves; it should be activated as soon as possible and have a participatory structure. Special incentives and motivation should be created in this context. The first priority is an extended attitude towards justice that goes beyond the regional perspective and also takes into account the global claims for justice related to climate change. The second priority is the financial promotion of structural change. This should use tendering formats to

encourage different constellations of actors to develop regional 'competitive contributions' to future-oriented decarbonization. The measures for activating regional initiative should constructively link up with existing decarbonization initiatives.

The strategic and procedural elements of the Zero Carbon Mission are explained in greater detail in the following.

Commitment by higher political levels to the global phase-out of the coal economy is of great importance for the successful initiation of regional processes. This can be linked up with ongoing initiatives. At the nation-state level, for example, there is the German 'Coal Commission' (Commission on Growth, Structural Change and Employment). National commissions play an important role in developing overall societal compromise and overcoming lock-ins without themselves assuming concrete responsibility for the local transformation processes. In the WBGU's opinion, the establishment of a corresponding body is advisable for all countries that have a significant coal industry. At the EU level, there is the European Commission's 'Coal Regions in Transition' initiative. The European Commission's support measures help existing actors with regional responsibility to make better use of funding instruments and promote the exchange of ideas and information between different regions of the EU. The international, interregional exchange platform within the framework of the 'Coal Regions in Transition' should be extended specifically to include further coal mining regions of the world.

In order to convince hesitant nations in the EU, the

Recommendation

Implement a Zero Carbon Mission as an overarching campaign for the coal phase-out

WBGU also recommends gearing all EU structural funding much more towards decarbonization, for example by setting corresponding guidelines for a large proportion of EU regional funding. In this way, the momentum can spread across all levels right down to the regions via EU mechanisms that co-finance national tendering processes in regional development. In the course of the Zero Carbon Mission, the need for rapid decarbonization should be laid down at all levels as an overarching guideline, so that top-down initiatives (such as guidelines and rules, EU and national financial resources) are directly linked with active bottom-up initiatives (ideas, commitment, motivation, diversity from the region). The existing national calls for tender within the EU for supporting co-financed regional development are well suited for activating regional decarbonization efforts.

Recommendation

Redirect EU structural funding increasingly towards decarbonization

Within the framework of the Zero Carbon Mission, regional actors should, for several reasons, be the people responsible for proactive structural change away from coal. They have the best knowledge of the local potential that can be used quickly and in a target-oriented way to encourage alternative, future-oriented economic activities. They are the quickest to recognize how innovation can be used to create new horizons and where the planned phasing out of coal in the sense of 'exnovation' (i.e. abolition of the old) should begin (Heyen et al., 2017). Similarly, an inhibiting basic feeling of 'being transformed' from the outside or from above can best be avoided at the regional level by inviting all those potentially affected by the coal phase-out to actively help shape the transition and develop new, shared visions of their own region. These can include, for example, businesses, employees, politicians, economic developers, chambers of trade and industry, research institutions and societal interest groups.

The WBGU therefore recommends that regional or local governments – even civil-society groups – should institutionalize regional transformation initiatives. They would draw up a vision and roadmap for decarbonization that is future-oriented, *just & in-time* and based on local potential and resources. They should be able to act

as independently as possible, be established for the long term, and be supported by people with professional process-management skills who, for example, can open up links to an entire network of transformation regions. The interests of future generations should also be explicitly incorporated. This can be achieved via selected 'representatives of the future' or ombudspersons; alternatively, the entire initiative could take on the character of a 'parliament for the future' or a citizens' consultative body. Some ideas on this have been presented by the WBGU and further discussed by other authors (WBGU, 2011:210ff.,281; Gesang, 2014; Leggewie and Nanz, 2016; Rose, 2018).

There are psychological requirements for managing disruptive structural change constructively (Box 1). These suggest that inclusive, transparent participation procedures headed by politically independent, professional moderators should be initiated to develop regional contributions for mastering the coal phase-out. The WBGU recommends setting up a professional agency to offer interested regions in the EU and beyond expert advice on short- and long-term process design. This process support would promote mutual understanding and convergence and also integrate marginalized actors. In the course of the participation procedures, those who, for various reasons, act as preservers of the status quo should be asked about their specific needs and persuaded to share common visions of the future.

Recommendation

Institutionalize regional transformation initiatives and give them professional support

The collection of ideas in Box 2 can provide helpful orientation for mapping out pathways towards decarbonization which can be constructively taken up as an opportunity. In this context, the guiding principle of 'related variety' can be combined with the 'greening' of companies and clusters, and in particular with the 'green mainstreaming' of structural policy on the ground. For example, the phasing out of coal could be used as a transformation pathway towards an economic region that develops – or innovatively applies – modern, digital technologies in order to advance sustainable energy systems, future, resource-efficient produc-

tion systems, or the development of new materials. An energy industry and power generation already exist in the coal phase-out regions. Innovations in and using digitalization offer new potential in this area for alternative value chains, research fields, companies, careers and jobs. The structure of a modern energy industry is more decentralized, smaller-scale, more flexible and more digital; it requires a greater exchange of basic data and information between the parties and integrates not only the electricity sector, but also the fields of heating and transport (Zinnöcker, 2017). Guiding concepts like 'Cluster', 'Learning Region' and 'Regional Innovation System' (Box 2) offer further starting points for using research-based approaches to make regions fit for the future. Ultimately, regions in transition should re-think their role and become important 'transformation pioneers' that make the most of their options for designing a modern and sustainable commercial development as fast as possible.

The WBGU also recommends the creation of a transnational cooperation network of transformation regions. Based on the successful C40 city network, the 'R40' transformation regions would exchange experience and knowledge and support participatory processes.

Recommendation

Launch an 'R40' transnational cooperation network of transformation regions

The network could encourage transformation regions – both within and outside Europe – to join this globally important cooperation. Systematically processed research findings on successful problem-solving structures and transformation policies can be integrated into this network. The network can also simplify constructive links between existing decarbonization initiatives in the respective regions. The networks of transformation regions in different parts of the world could boost an understanding of global justice that includes all those people affected by climate change. Furthermore, additional state or philanthropic support services could be offered or coordinated via the network. Similarly, the proposed agency for professional process support could be part of the R40 network.

To make experience from past structural-change processes available, the WBGU recommends funding

research into the success factors of regional transformation and socially acceptable exnovation pathways. In addition, research institutions themselves should be supported in their role as agents of transformation. Decarbonization in the regions should become the overall guiding concept of national schemes for funding productive interactions between science and business. The WBGU recommends that the German Federal Ministry for Education and Research (BMBF) should correspondingly provide targeted support for cooperation between science and business specifically for these 'decarbonization regions'. Along the lines of the BMBF's framework programme 'Research for Sustainable Development' (FONA) – or based on funding competitions for regional consortia of 'Cluster' development or 'Learning Regions' – decarbonization could be made the main leitmotif of scientifically supported regional economic transformation processes (e.g. what might be called a 'Decarbo-Regio' approach).

Recommendation

Fund research on regional structural change; strengthen the transformative role of research institutions in the regions

Furthermore, the WBGU recommends providing training in transformative literacy for as many affected citizens as possible. Lessons could be learned inter alia from successful industrial transformation and modernization processes in Scandinavia, where broad education measures for the population were regarded as key (Andersen and Björkman, 2017). In the discourse on 'just transition', education often focuses on retraining employees to qualify for new jobs. However, these jobs are very difficult to identify clearly – especially in times of profound change, e.g. as a result of digitalization – and it is difficult to predict which business models, companies or sector developments will follow. Transformative literacy for citizens goes beyond attaining qualifications for new jobs; it aims at building a broader range of skills for the transformation. It should also aim to enable people to participate successfully in transformative processes and future-oriented resilience strategies (Lietzmann et al., 2017; Wiek et al., 2014).

An orange speech bubble graphic with a tail pointing towards the top left. Inside the bubble, the word "Recommendation" is written in bold white text, followed by a line of white text.

Recommendation

Advance a transformative literacy initiative that goes beyond training for new jobs

Ultimately the aim must be to activate a large number of local actors to embrace decarbonization as a regional modernization project. In this way, the Zero Carbon Mission could breathe new life into the implementation of the global goals adopted in Paris.

Access to justice for people harmed by climate change

Consequences of climate change, such as melting glaciers, changes in precipitation patterns or increases in the number of extreme weather events, already threaten the life-support systems of many people. In many cases, the people affected are those who do not have sufficient financial resources to protect themselves against the consequences of climate change. The status of their legal claims against those responsible, i.e. primarily emitters of CO₂, is largely uncertain. Up to now, those responsible for climate change have hardly been held accountable at all for the loss and damage that is already occurring. By contrast, companies whose emissions contribute to climate change (e.g. operators of coal-fired power plants) can, in certain circumstances, expect to be compensated if, in the course of decarbonization, their plants are closed down by state authorities before their licences expire. If there is no state compensation, the companies can assert their rights based on the freedom to enjoy property rights and pursue a trade or profession, and in this way launch compensation claims in the courts. In the WBGU's view, this asymmetry in the enforcement of legal claims for damages between people affected by and companies responsible for climate change leads to an imbalance that obstructs a *just & in-time* transformation.

All those involved in a just transformation should be equally entitled to legal remedies; both those affected by transformation-induced structural change and those harmed by climate change.

Up to now, the international community has concentrated its efforts on mitigation and adaptation measures financed, for example, by the Green Climate Fund or the Adaptation Fund. In Article 7 of the Paris Agreement (PA), the international community recognized adaptation to climate change as an important field of action, thus giving it equal status with climate-change mitigation. Furthermore, international mechanisms for the exchange of information and needs were set up and financial support provided for (Sands et al., 2018:325). Far less attention is paid to losses and damage caused by climate change that are already a reality today. To date there are no signs of the international community making adequate efforts to compensate for – or where possible reverse – loss and damage. Although the Parties

recognize the need to address the issue (in Article 8 of the PA), at the same time, in the declaration on the recognition of the convention, they state that Article 8 of the PA shall not lead to any mandatory compensation payments (UNFCCC, 2015). The mechanism for loss and damage adopted at the 19th session of the Conference of the Parties in Warsaw has so far not made it possible to close the financing gap (Gewirtzman et al., 2018; Johnson, 2016). Recently, therefore, there have been discussions on the possibility of increasing political pressure on the international community to pay more attention to this area by filing pioneer lawsuits in the field of loss and damage (Bals et al., 2018; Boom et al., 2016; UNEP, 2017).

The WBGU recommends that the German Federal Government should support lawsuits filed by individuals against large-scale emitters. Up to now, people affected by climate change have hardly filed any lawsuits, among other reasons because of the financial risks associated with such lawsuits. Enhanced international cooperation in the provision of legal aid and in financing pioneer lawsuits could change this situation. Although pioneer lawsuits are only small building blocks for a fair balance in the field of climate-change-related loss and damage, their global symbolic effect should not be underestimated. Such lawsuits highlight for the public the global dimension and interdependence involved in the causation of climate change and its impacts. Pioneer lawsuits contribute to the further development of the law, reveal gaps in protection, and in this way directly and indirectly accelerate the adjustment of legal systems to the global challenges of climate change. They can also have a preventive effect and generate fresh impetus for strengthening global climate protection, e.g. through investments in mitigation measures. Lawsuits of people harmed by climate change must also be filed in a *just & in-time* manner. Only timely legal remedies are effective legal remedies. At present, there is still a chance to hold large companies whose business models are based on fossil energy carriers (e.g. operators of coal-fired power plants) legally accountable. After all, profits are still being made with these business models.

Global increase in the number of lawsuits relating to climate change

The number of lawsuits relating to climate change is increasing worldwide (Boom et al., 2016; UNEP, 2017). Since 1986, a total of 878 cases involving references to climate change were recorded in the USA and 265 cases outside the US (Sabin Center for Climate Change Law and Arnold & Porter, undated), although the underlying US database does not claim to be exhaustive. A wide variety of lawsuits were registered, and, of these, pioneer lawsuits for compensation due to climate-related loss and damage were the exception. Climate-change-related lawsuits differ according to defendants (government authority or private company), cause of action (mitigation, adaptation, loss and damage) and plaintiffs (individual, organization, or state entity).

Companies are rarely sued for damages under civil law because of their climate-damaging actions, but more often for breaches of specific environmental laws.

Most legal proceedings relating to climate change are directed against state authorities that have licensed or are (inadequately) monitoring industrial plants or infrastructure projects with an environmental impact, or are themselves violating national (climate-change-mitigation) law. In South Africa, for example, a High Court found that state approval of a private-sector coal-fired power plant, which had not been sufficiently scrutinized in terms of its environmental compatibility, had been granted illegally (UNEP, 2017: 38). The Federal Administrative Court in Austria found that the expansion of the public-private airport in Vienna was not compatible with the emissions-reduction targets stipulated in Austrian climate-protection law (UNEP, 2017: 38). However, the decision was quashed shortly afterwards by Austria's Constitutional Court. Some lawsuits are also directed explicitly *against* administrative climate-change-mitigation and adaptation measures, e.g. by private individuals whose freedom to enjoy property rights or pursue a trade or profession is affected.

Another important category is made up of lawsuits filed by citizens or non-governmental organizations against their own governments to force them to take climate-change-mitigation or climate-adaptation measures. For example, a Pakistani citizen sued the state of Pakistan for its lack of action to put the national strategy on climate change and the 2014–2030 implementation framework into practice (High Court Lahore, 2015). In the Netherlands, a non-profit organization committed the government through the courts to maintaining the previous government's ambitious climate-change-mitigation targets (The Hague District Court, 2015). Ten families from Germany, Fiji, France, Italy, Kenya, Portugal and Romania, as well as a Swedish non-govern-

mental organization, jointly filed a lawsuit against the European Parliament and the Council before the Court of First Instance, to commit the EU to more ambitious emissions-reduction targets and measures – in addition to the annulment of the Emissions Trading Directive (People's Climate Case, 2018).

Up to now, hardly any lawsuits have been filed by individuals against private companies. Large-scale emitters are more likely to be sued in court for individual damage by a public-sector plaintiff. For instance, a new wave of lawsuits filed by US cities against the major oil and energy companies began in 2017 and 2018. They were demanding compensation for damage to their cities that could be ascribed to climate change. For example, since January 2018, the city of New York has been suing major US oil companies before a federal court. It accuses BP, Chevron, Conoco-Phillips, Exxon Mobil and Royal Dutch Shell of having caused 11% of total global greenhouse-gas emissions through the production, marketing and sale of fossil fuels, despite having known for a long time that this caused considerable damage (United States District Court Southern District of New York, 2018). The city claimed they had tried to conceal this fact. The city of New York is therefore demanding that they assume the costs of adaptation measures in order to ward off climate-change-related risks to public infrastructure and public property, public health, safety and inhabitants' property. As long ago as 2008, an indigenous village in Alaska filed a lawsuit for damages in the US courts against oil and energy corporations; the village had become uninhabitable as a result of the climate-change-related erosion of sea ice. The lawsuit was later rejected by a higher court, which stated that climate change had been politically addressed in the USA by the Clean Air Act and was thus outside the general liability regime (United States Court of Appeals for the Ninth Circuit, 2012).

In the following, the WBGU focuses on lawsuits filed by individuals against private-sector, large-scale emitters, because, up to now, such opportunities for filing lawsuits have not been exploited to their full potential and because large-scale emitters have contributed far too little in the fight against climate change.

Barriers to effective legal remedies

Up to now, very few people who have been harmed by climate change have taken private-sector large-scale emitters to court. The lawsuit against RWE filed in Germany by a Peruvian farmer is therefore attracting a great deal of media interest (Box 3).

People like the Peruvian Saúl Luciano Lliuya who want to sue private-sector large-scale emitters for their

Box 3**David and Goliath: farmer takes on RWE**

Since 2015, a lawsuit that can be described as a pioneer lawsuit has been causing quite a stir; it was filed in German civil courts by the Peruvian farmer Saúl Luciano Lliuya against the RWE energy corporation. The plaintiff lives in a Peruvian city that lies below a glacial lake whose water level is continuously rising as the glacier melts. The banks of this natural pool have already burst and flooded the town once. Subsequently, dikes and runoffs have been built as protection measures. Since they are no longer sufficient, there is a threat of another flood. Mr Lliuya is suing RWE for pro-rata defrayment of the costs for additional protection measures. RWE's causal contribution to global greenhouse-gas emissions, which is assessed at 0.47%,

would determine their share of the costs, so that RWE are being asked to contribute approx. €17,000 towards the new dam's construction costs. Although the Peruvian lost in the first instance (Landgericht Essen, 2016), the second instance, the Higher Regional Court in Hamm, regards the plaintiff's application as convincingly substantiated following a preliminary assessment (Oberlandesgericht Hamm, 2017), and has initiated the hearing of evidence. It remains to be seen whether the plaintiff succeeds in proving the facts on which his claim is based, in particular the causality between RWE's greenhouse-gas emissions and the threat of flooding in the Peruvian town. Mr Lliuya is being supported in his lawsuit by, among others, a German non-governmental organization, which also set up the contact with a German lawyer, as well as by a foundation that is covering the financial risk of the lawsuit (Germanwatch, 2018).

rights face three major hurdles: the problem of the liability link and the burden of proof; the risk of legal costs; and the problem of a timely legal remedy.

The problem of the liability link and the burden of proof

Up to now, no court has ever recognized a liability link between individual emissions and a specific past or impending case of loss or damage caused by environmental changes or extreme weather events attributable to climate change. While it is true that any specific liability on the part of large-scale emitters depends on the respective legal system and how it treats the obligations of private individuals toward other private individuals or the state, responsibility in terms of liability law can generally only be confirmed if the plaintiff can prove in a consistent line of argument that the damage was caused by a specific, individual greenhouse-gas emission (causality link or causality). In particular, it must be proved that (1) greenhouse-gas emissions from a specific source contribute to climate change, (2) climate change leads to the relevant environmental changes and events, and (3) these environmental changes cause specific loss or damage or a specific impairment of property for the person or group of persons affected. Furthermore, (4) it is controversial whether loss or damage caused by climate change as a whole can be attributed to a specific greenhouse gas emitter (attribution link).

Emission and damage are geographically and temporally separated. A frequent dispute is about whether liability consequences can be derived from this. If a lawsuit is to be successful, plaintiffs must, depending on the legal system, prove – or at least make plausible – all the prerequisites of a claim for damages for their lawsuit to be accepted by the court. They must also quantify the extent of the damage. The defending large-scale emitters' respective share of global CO₂ emissions can also become relevant for the calculations if they are to com-

pensate for the damage on a pro rata basis according to their causal contributions. This distribution of the burden of proof is a major obstacle for the plaintiffs if they do not have access to the corresponding data. Science is making progress on proving links between causes of climate change and specific effects (Box 4).

In the WBGU's opinion, the legal attribution of damage to certain emissions should be clarified in court not only in Germany, as in the case of the lawsuit filed by Mr Lliuya, but also in different national legal systems on the basis of as many constellations as possible. Depending on the respective legal order, judges have different ways of influencing the development of the law. Developments of the law by judges can, for example, shift the burden of proof from the plaintiff to the defendant corporations. Because of their access to internal corporate data and their own research departments, the companies have a considerable knowledge advantage over the plaintiffs. Another example might be the development of climate-change-related due-diligence obligations by case law. Due-diligence obligations are obligations to safeguard the interests of the public or third parties, e.g. companies' duty to inform (Box 5). Legislators, too, can order shifts in the burden of proof and perhaps a duty to inform, thus making it easier to establish proof or even eliminating the problems involved in doing so.

The problem of the legal cost risk

Legal proceedings involve a cost risk for an individual plaintiff, especially when the prospects of success are difficult to assess – as in the field of climate-change-related damage. In civil litigation, the losing party usually pays the court costs, sometimes also the other party's attorneys' fees. Commissioning experts can involve significant advance payments and, in the case of failure, lead to costs for the plaintiff. For example, in the case of Lliuya vs. RWE, €20,000 in experts' fees had to be paid in advance in order to initiate the hearing of evidence.

Box 4

Proving causality links

From a scientific point of view, there is no doubt: climate change is taking place, and the influence of mankind is unequivocal (IPCC, 2015). The warming over the last 50 years can only be explained with the help of the observed increase in atmospheric concentration of CO₂. Anthropogenic emissions, predominantly from the combustion of coal, oil and natural gas, are unequivocally the cause of this increase in CO₂. This is also shown e.g. by the simultaneous decline in the atmospheric oxygen content, which is clearly measurable and is caused by the burning of fossil fuels (Ciais et al., 2013). CO₂ from fossil sources is not the only driver of anthropogenic climate change, but by far the most significant (IPCC, 2014; WBGU, 2014). Since CO₂ has a long life-span and accumulates in the atmosphere, it is almost evenly distributed in the atmosphere. Emissions from an individual emitter therefore spread throughout the entire atmosphere and thus contribute to global warming. Many effects of climate change can also be proven. As a rule, the scientific proof is furnished by assigning observed impacts

to the observed climate change. However, the latter represent an overlapping of anthropogenic climate change with natural climate fluctuations, so that the influence of anthropogenic climate change cannot always be isolated (IPCC, 2014). In the last few decades, climate change has had an impact on natural and human systems on all continents and in all oceans. The impacts that have been attributed to climate change include, for example, changes in the hydrological systems due to changes in precipitation, the melting of snow and ice, coastal erosion, sea-level rise and reduced crop yields. Changes in extreme events have also been observed since 1950, some of which have been linked to the influence of humankind. These include, for example, the decline in cold and increase in warm temperature extremes, an increase in extremely high sea levels (e.g. storm surges) and the increased frequency of heavy precipitation in several regions, which leads to increased flood risks (IPCC, 2014). Research on the relationship between extreme events and anthropogenic climate change has made considerable progress in recent years. In the meantime, it has moved beyond a merely statistical connection and also analyses the influence of climate change on individual extreme events (WMO, 2018).

The principle of the rule of law requires state legal aid for everyone to provide access to the courts regardless of a person's financial resources. Economic need is a prerequisite for an application for legal aid. Especially in the Least Developed Countries, the available budget for legal aid in support of civil proceedings is not sufficient to cover the demand (UNODC, 2016). Even if a lawsuit is financed by legal aid, plaintiffs take the risk of having to reimburse the successful party's out-of-court costs, e.g. travel expenses to the court or printing costs. In addition, plaintiffs incur travel costs and other expenses. Current lawsuits are therefore often initiated or supported by non-governmental organizations (e.g. Client Earth).

The problem of timely access to justice

Even if the liability link is successfully proven and sufficient financial support is available, the duration of the court case and the time span between causation and damage could represent a problem. This is demonstrated by the successful lawsuits filed by building workers against construction companies in the USA and Australia for compensation for damage to their health caused by working with asbestos. Like emissions, which accelerate climate change, asbestos causes damage that only has an effect after a time lag. By the time the damage became evident, the companies responsible for the installation of asbestos had either become insolvent or evaded national jurisdiction by moving abroad or reorganizing their corporate structures. Such a development also threatens when it comes to the liability of private companies for climate-related loss and damage (Boom et al., 2016). Thus, large-scale emitters are cur-

rently already unbundling the divisions responsible for no-longer-profitable fossil fuels from the highly profitable renewable-energies divisions, thus shifting profits (Boom et al., 2016). Companies can only be held legally accountable for their greenhouse-gas emissions if the emitters of historical emissions legally and factually still exist at the time of the decisive litigation. Legal remedies are only effective for those affected if they are implemented quickly, i.e. before the defendants have restructured their companies and can no longer be held liable.

Recommendations for effective access to justice for people harmed by climate change

The above analysis shows that unpredictable prospects of success and the risk of legal costs are the deterrents most likely to discourage those affected by climate change from initiating legal proceedings. The growing risk of losing a solvent defendant as time passes further underlines the urgency of launching climate-related lawsuits against private companies in good time.

In the WBGU's view, lawsuits filed against companies by people who have been harmed by climate change can contribute towards realizing a *just & in-time* transformation. A development of the law in this area is urgently needed. Furthermore, lawsuits can also be a trigger and driver for the long-term establishment of mechanisms to ensure just compensation for those affected by climate change. Particularly urgent is a joint and ambitious approach to the prevention, reduction and handling of loss and damage in accordance with Article 8 of the PA.

Box 5

Lawsuits against the tobacco industry

The difficulties of climate lawsuits are similar to those of lawsuits that have been filed by individuals against the tobacco industry in the USA since the mid-20th century. As at the beginning of the wave of lawsuits against the tobacco industry in the USA, there are reservations regarding the chances of success of climate lawsuits against private-sector large-scale emitters. While the legal doubts connected to climate lawsuits relate particular to the causation link, the main issue involved in the tobacco lawsuits was the extent to which the problems were the smokers' own fault.

Although not all the lawsuits against the tobacco industry were successful (Molitoris, 2004), they certainly had far-reaching consequences. They have helped make the public aware of the health implications of cigarette consumption, opened up direct access to a wide range of internal corporate documents

on the impact of tobacco consumption, and reduced the political influence of the big tobacco companies (Boom et al., 2016). As a rule, lawsuits against the tobacco industry sought damages for a violation of due-diligence obligations by misinforming the public about the harmful effect of cigarettes on health. The issue was not compensation for the harm itself that was caused by the nicotine, but the reimbursement of a percentage of the cigarettes' purchase price. To this extent, unlike in the case of the climate lawsuits, it was not necessary to prove causality between cigarette consumption and specific damage to health. In a similar way to the tobacco lawsuits, the courts could develop special due-diligence obligations in relation to greenhouse-gas emissions: e.g. a duty on the part of large-scale private emitters to provide information about possible damage or to stop causing damage because they are aware of the harmful nature of high greenhouse-gas emissions. The major oil companies themselves have been researching climate change, its man-made origins and its consequences at least since the 1970s (Wang, 2018).

In the WBGU's opinion, countries with high emissions where large-scale emitters are based have a particular obligation to enable people harmed by climate change to file court lawsuits for preventive measures or damages. Germany should take the initiative here, both nationally and internationally.

Recommendation

Promote fair compensation for those affected by climate change through the judicial development of the law

The WBGU proposes some simple ways to improve the starting position of potential plaintiffs:

- *Strengthen international cooperation in legal aid:* The international community should ensure that the enforcement of compensation claims for loss and damage does not fail for lack of access to the courts. People threatened by significant climate-related loss and damage should be given effective opportunities to file lawsuits across national borders. In particular, the respective national laws on legal aid should be reviewed to ensure that it is adjusted to accommodate the new plaintiff groups. All nation states should accede to the Hague Convention on International Access to Justice to improve institutional access for

citizens from states particularly affected by climate change to the courts of the states where large-scale emitters are based. The Hague Convention provides for a cooperation framework, through which courts and authorities in the state of the plaintiff are in contact with the courts and administrative authorities of the state in which the lawsuit is filed (i.e. usually the seat of the defending large-scale emitters). In this way, the applications for legal aid can also be filed for decisive litigation abroad in the plaintiff's country. Support for translations and formalities should also be guaranteed. At present, the Hague Convention is only valid in 28 countries. Germany has signed but not yet ratified it, so that it is not legally binding in Germany.

Recommendation

Create effective opportunities for people harmed by climate change to file lawsuits across national borders through international cooperation in legal aid

- *Provide financial resources for pioneer lawsuits:* New pioneer lawsuits can be financed quickly and pragmatically via funding from the regular budget for development cooperation. The German Federal Government should make an annual budget of €10-25 million available to enable individuals or groups

harmed by climate change to assert their legal rights. The WBGU recommends setting up an independent commission for allocating funds that would assess such a lawsuit's chances of success on the basis of climate research, development policy and legal expertise. The aim should be to fund such lawsuits where a causal relationship between anthropogenic climate change and the corresponding effects is plausible, and where those affected are economically needy and especially vulnerable to the effects of climate change. Wherever possible, the funds should be assigned to appropriate non-governmental organizations that would supervise the corresponding processes to provide suitable support for the individuals concerned. Communities or municipalities should also be able to apply for the funds if they can prove to the commission that they have enough human resources but lack the financial capacity to seek pioneer lawsuits. The funds should cover all the litigation cost risks, i.e. both the legal costs themselves (if legal aid cannot be applied for) and other extrajudicial costs that would be incurred to make the lawsuit possible.



Recommendation

Finance selected pioneer lawsuits filed by people harmed by climate change against large-scale emitters in the context of development cooperation

In Nansen's footsteps: a climate passport for humane migration

After the First World War, the turmoil it triggered led to an unprecedented refugee crisis. State systems collapsed, borders were heedlessly moved, millions of people lost their national identities through civil war, expulsion or flight. In particular, countless people were on the move without valid identification documents. In 1922, in order to alleviate this humanitarian hardship at least to some degree, Fridtjof Nansen – world-famous polar researcher and then High Commissioner for Refugees at the League of Nations – invented an international legal instrument to protect migrants. It was a passport for stateless persons to be recognized by as many countries as possible that would grant the bearer access to the respective state territory. This far-sighted innovation, which was known as the Nansen passport, was honoured with the Nobel Peace Prize. Up until 1938, it gave hundreds of thousands of people the right to hospitality in safe states. By 1942, as many as 52 nations had recognized the Nansen passport in principle (Mararus, 2013).

In the 21st century, we are at the beginning of a refugee crisis that cannot be compared with the early 20th century in terms of cause and dynamics, but could ultimately lead to even greater suffering. We are talking about anthropogenic global warming, which is raising sea levels, changing the global water cycle, aggravating extreme weather regimes, shifting entire vegetation zones, and thus threatening the life-support systems of hundreds of millions of people. Even today, at a time when the planetary surface temperature has only risen by about 1°C, climate-induced migration movements are already taking place (Ionesco et al., 2017; IDMC and NRC, 2017). The refugee crisis in the Middle East and Europe triggered by the civil war in Syria could well be causally linked to climate change, because the worst drought in a millennium in the 'Fertile Crescent' has been aggravating social and political tensions in the region since 2011 (Kelley et al., 2015, 2017).

There is certainly no denying the causal link between man-made climate change and the existential threat to low-lying island states. Even if limiting global warming to 2°C were to succeed, a rise in sea levels of around one meter would deluge entire territories – and thus wipe out national identities in the conventional sense

of international law (Storlazzi et al., 2018). The peoples affected would then only be able to ensure their survival by leaving their disappearing countries.

Whether the threat comes from flooding, drought or devastating tropical storms, the most vulnerable groups often remain trapped in extremely precarious situations, for example if they cannot afford to migrate (Adger et al., 2014). It is unbearable to imagine millions of climate migrants in the coming decades becoming dependent on criminal people-trafficking organizations like the ones currently causing such terrible human misery in the Mediterranean. It is unfortunately the case that, although the international community has been paying more attention to climate-induced migration in recent years, the legal and political solution approaches are inadequate and unable to provide suitable, *just & in-time* assistance to the growing number of people affected.

Migration in times of climate change is, by its very nature, an extraordinarily complex, multi-causal and controversial challenge (Adger et al., 2014). The way the victims are treated will become an ethical touchstone for the international community in the 21st century. If the environmentally-induced geographical displacement of a large number of people, often over considerable distances, is a necessity, then what solutions, if any, are possible?

Historically, there are many examples of measures and modes of behaviour that have contributed to the success or failure of migration and refugee movements (Fiddian-Qasmiyeh et al., 2014). Perhaps the most terrible lessons can be learned from the suffering of the Jewish minorities in Europe after 1933, when the international community failed almost totally (Thies, 2017). The range of possible approaches includes two that are both particularly important and diametrically opposite in character. On the one hand, there is the centralist-authoritarian plan, where the migration movement is controlled from above. Stalin's brutal resettlement policy after the Second World War provides the most negative point of reference here. Of course, there have also been other, more well-meaning strategic attempts to resettle population groups in recent history, but none of them have been really successful – whatever yardstick is used to judge them (Oliver-Smith and de Sherbinin, 2014).

On the other hand, there is the individual approach like the one pursued by Fridtjof Nansen. It aims at enabling individuals to decide freely on emigration. To this extent, it constitutes the humanistic alternative to planned migration. *It gives the individual person dignity through a right to mobility.* This is also the approach that the WBGU recommends to deal with the imminent climate-related migration crisis.

The WBGU emphasizes that safe and legal emigration and immigration are not only the *ultima ratio* of adaptation to climate change, but also something to which the people affected are entitled as compensation for the vital and cultural loss and damage incurred with the loss of their homes.

The WBGU therefore proposes a *climate passport for migrants* as a key instrument of a humane climate policy. Based on the Nansen passport, this document would offer people existentially threatened by global warming the option of having access to – and rights equivalent to citizens' rights in – largely safe countries. In the first phase, the climate passport would open up early, voluntary and humane migration pathways to the populations of small island states whose territory is likely to become uninhabitable as a result of climate change. In the medium term, the passport should also be available to people under massive threat in other countries, including internally displaced people. States with considerable historical and present-day greenhouse-gas emissions, which therefore bear a considerable amount of responsibility for climate change, should offer their services as host countries. By way of contrast to authoritarian or nationalist migration planning, the climate passport would thus be a highly symbolic example of a liberal adaptation policy.

Climate-induced migration: a phenomenon of growing importance

The term 'climate-induced migration' is used in the following to denote migration and refugee movements in which the impact of climate change plays an important causal role. Climate-induced migration comprises a large number of phenomena (McAdam, 2014; Warner, 2011), including voluntary and involuntary migration, migration as a result of sudden onset disasters (e.g. caused by extreme weather events), and population movements caused by slow onset disasters (e.g. caused by gradual climate changes). For the most part, the decision to migrate is taken somewhere along a spectrum ranging from voluntary to enforced (Adger et al., 2014).

Individual migration decisions are usually based on a whole bundle of personal motives (climatic, political, economic, social; Hanschel, 2017), so that it is often

methodologically problematic to ascribe migration to climatic changes alone. Furthermore, a clear distinction can hardly be made between the effects of sudden and slow climatic consequences, or between general environmental changes and specific changes in the climate. For example, a gradual rise in the sea level combined with a hurricane can trigger a mass migration. In addition, not only climate change but also tectonic uplift and subsidence can lead to changes in the sea level, as for example in Vanuatu (Kelman, 2015). Narrowing one's perspective to climate-change-related migration alone sometimes leads to considerable difficulties in establishing proof (Nümann, 2015). This perspective is also at risk of being accused of weakening the position of environmental migrants who migrate for other ecological reasons vis-à-vis climate migrants (Brouers, 2012). Despite these methodological difficulties, global development trends suggest that climate change will become an increasingly important factor in migration decisions in the future, and that global migration movements are increasingly likely to be at least partly influenced by climate change (Adger et al., 2014; Rigaud et al., 2018; McAdam, 2014; Vinke et al., 2017; WBGU, 2008, 2014).

Because of the above-mentioned methodological difficulties and the small number of studies available, up to now there are no reliable global and comprehensive forecasts on the phenomenon. Nevertheless, an attempt is made in the following to estimate the likely scale of climate-induced migration on the basis of existing studies. Scientific estimates of global environmentally-induced migration up until 2050 vary greatly – from 25 million to up to 1 billion people affected – and this reflects the methodologically unclear situation (Ionesco et al., 2017). About 80% of migration worldwide takes place not across borders, but within countries (internal migration; Adger et al., 2014). In 2016, approx. 24.2 million internally displaced people worldwide were on the move because of sudden onset disasters such as floods, storms and bush or forest fires (IDMC and NRC, 2017). From 2008 to 2016, a total of around 228 million people had to leave their ancestral homes either temporarily or permanently because of such disasters; that corresponds to an average of about 22.3 million people per year. The overwhelming majority of these disasters were climate and weather-related, i.e. not caused by tectonic events such as earthquakes, tsunamis or volcanic eruptions (IDMC and NRC, 2017).

These figures only give a limited picture of the extent of environmental migration, because they only take into account migration movements due to sudden onset disasters. The migration impact of gradual changes (e.g. land degradation, ground-water salinity, drought) should be added to these figures, but only rough estimates exist for these. The World Bank estimates that

Box 6**The existential threat to low-lying island states**

Even without climate change, island states have been marked by international and internal migration for quite some time (Weir et al., 2017). However, climate change is leading to a new kind of existential threat to these countries (Nurse et al., 2014). Through a combination of sea-level rise, land erosion, El Niño-driven droughts and heat waves, and saltwater intrusion into the groundwater, between 1.2 and 2.2 million people could lose their traditional residential areas on islands in the Pacific and Indian Oceans, as well as in the Caribbean (Nicholls et al., 2011). The most vulnerable and severely affected population groups often have the least financial means to migrate. They risk becoming so-called ‘trapped populations’ (Foresight, 2011) who need help to escape their precarious situation. Island states deemed to be particularly at risk due to climate change are e.g. Kiribati (110,000 inhabitants), the Maldives (345,000 inhabitants) and Tuvalu (11,000 inhabitants; Kelman, 2015).

In the framework of the UN climate change conferences, the Alliance of Small Island States therefore calls for rapid reductions in emissions and for a 1.5°C limit for global warming (AOSIS, 2017). The countries concerned have different ways

of dealing with climate-induced migration. For example, under the motto ‘Migration with Dignity’, the government of Kiribati urges industrialized countries to accept their responsibility for climate change and grant compensation in the form of migration agreements. Like other states, it places great value on better local education to enable labour migration (Müller et al., 2012:43; McNamara, 2015). Kiribati has furthermore purchased land in Fiji, so that a resettlement of the population would be possible (Kälin, 2017). By contrast, the governments of Tuvalu and Micronesia fear that the developed countries will evade their responsibility for emissions reduction if they believe that problems like rising sea levels can be ‘solved’ by resettlement (McAdam, 2014).

Some states are benefiting today from historical agreements. Since 1985, the Marshall Islands, Palau and the Federated States of Micronesia have maintained a Compact of Free Association with the USA that also grants them extensive migration rights to the United States (Nicholls et al., 2011). This agreement was drawn up to succeed UN trusteeship after the Second World War and is also based on military alliances. It is gaining in importance today because of the threat to the islands posed by climate change (Davenport, 2015). Tokelau, Niue and the Cook Islands are associated with New Zealand. Their inhabitants have New Zealand citizenship, so that they can migrate there (McAdam, 2014:36).

143 million people in sub-Saharan Africa, South Asia and Latin America will have been displaced by climatic impacts within their own countries by 2050 if no action is taken (Rigaud et al., 2018). Furthermore, the importance of internally displaced persons is expected to rise further in the future (Lilleør and van den Broek, 2011). Yet climate change does not always lead to an increase in people’s mobility. The consequences of climate change can exacerbate the situation of vulnerable groups in particular to such an extent that migration without outside help is not (or no longer) an option (Adger et al., 2014; Black et al., 2013).

Low-lying island states have a ‘unique selling point’ in relation to climate-induced migration. In extreme cases, it is questionable whether the island population can stay in their own country, and in some countries the very physical existence of the state territory is threatened by climate-induced sea-level rise (Box 6). For example, a business-as-usual scenario could already make many atolls uninhabitable by the middle of the 21st century as a result of increased flooding (Storlazzi et al., 2018).

The WBGU recommends that the German Federal Government should fund interdisciplinary research on climate-induced migration in order to promote a better understanding and develop long-term and flexible protection options.

Recommendation

Promote interdisciplinary research on climate-induced migration

The legal framework of climate-induced migration

Climate-induced migration affects various fields of action, in particular human rights, migration and asylum, the environment and climate, security and development, and humanitarian disaster-control systems (Kälin, 2017; McAdam, 2014:215). Legal protection is developed and discussed primarily for climate-induced migration caused by natural disasters and acute emergencies. However, this hardly takes into account that climate-induced migration should ideally be based on a voluntary, early and self-determined decision. The climate passport is a people-oriented, liberal tool for making this dignified migration option possible. It supplements the few non-binding programmes and declarations on the protection and support of migrants by adding an urgently needed binding protection option that makes legal migration possible.

Up to now, there has been no provision for such an instrument in international agreements. The framework of protection for every human being is laid down by human rights. However, only in a few cases can concrete claims for protection be derived from these rights (McAdam, 2014: 53,98). In the case of cross-border migration, the Geneva Refugee Convention creates a right to protection under strict conditions. However, climate migrants cannot invoke the international protection of refugees, since this only grants protection from intentional human actions (e.g. persecution for reasons of religion or political convictions), but not from environmental changes and natural disasters (Nümann, 2015). The question of an amendment to the Convention to benefit people displaced by natural disasters has frequently been raised, but – probably with justification – rejected, since this could mean a weakening of the existing consensus among states on the Geneva Refugee Convention (Hanschel, 2017).

Negotiations are ongoing on new international pacts on displacement and migration; these will provide an opportunity to get the topic of climate- and environment-induced migration enshrined at a high level as an international field of action (Serdeczny, 2017). The New York Declaration for Refugees and Migrants, passed by the UN General Assembly in 2016 (UNGA, 2016), aims for the first time at a uniform statement on migration under international law: the Global Compact for Safe, Orderly and Regular Migration, which is expected to be adopted in December 2018. The draft Compact explicitly mentions climate change as a cause of migration and calls for multilateral cooperation on the identification, development and strengthening of solution strategies (UN, 2018). It thus has the initial characteristics of an international recognition of climate- and environment-induced migration.

Furthermore, in 2018, the UN High Commissioner for Refugees will submit an initial draft for a new Global Compact on Refugees. However, an expansion to also include environmentally-induced migration is not expected (Kälin, 2017). The WBGU nevertheless recommends integrating the topic of climate-induced migration into the various pacts, because this would reflect the complexity and growing relevance of the phenomenon and emphasize climate-related migration as a key creative task for the international community.

The same applies to the proposal of a Global Pact for the Environment (Le Club des Juristes, 2017), although official negotiations have not yet begun. The aim here is to summarize all key principles and rights under international environmental law (whether in a binding or non-binding form is still an open question). The Pact would also include a right to a healthy environment, which could support claims made by climate-induced

migrants. However, appeals in international pacts can only complement, not replace, practical cooperation within the international community, e.g. in the form of the climate passport proposed here. Although they strengthen the voice of climate-induced migrants, they do not generate directly reliable protection instruments and therefore do not offer a robust solution strategy.

Many agreements that are relevant for climate-induced migrants have been developed in the field of disaster control and to protect the internally displaced (Kälin, 2017). They are often based not on binding intergovernmental agreements, but on non-binding accords, declarations of intent or guidelines, also known as ‘soft law’ (Ferris and Bergmann, 2017). Internally displaced persons in Africa are protected by the Kampala Convention, which lays down binding obligations for the African signatory states (African Union, 2009; Nümann, 2014). The UN Guiding Principles on Internal Displacement (UN Commission on Human Rights, 1998) and the Cartagena Declaration (Colloquium on the International Protection of Refugees in Central America, Mexico and Panama, 1984) provide for comprehensive protection rights for internally displaced persons, if the migration is caused by an acute emergency (e.g. extreme weather events), but do not provide the basis for legally binding protection. Moreover, many states have voluntary disaster-control programmes for people affected by extreme weather events (Kälin, 2017). However, as a rule there are few plans that benefit people who migrate as a precaution, or because of gradual environmental changes, to escape the growing risks from natural hazards.

The Protection Agenda of the Nansen Initiative and the Platform on Disaster Displacement are making a major contribution to improving protection for migrants affected by natural disasters (Kälin, 2017). With the participation of over 100 countries and various other actors, the organization collects and develops instruments and procedures for preventing, preparing for and supervising disaster-related migration. The Platform also says that, together with the International Organization for Migration, it is working on processes for the precautionary planning of voluntary migration as an adaptation strategy (PDP, undated). The WBGU regards this process as promising and therefore recommends further developing this non-binding, but goal-oriented international cooperation. It creates an important, global framework that can provide substantial backing for multilateral instruments such as the climate passport. An important symbol of this initiative is that creative and organizational responsibility for the global phenomenon of climate-induced migration is also being assumed at a global level. Although vulnerable regions such as the low-lying island states are already

making preparations on their own initiative by means of regional or historic agreements (Box 6), in line with a *just & in-time* transformation these regions should be substantially supported by the international community, and particularly by states that bear considerable responsibility for climate change.

Recommendation

Use international pacts and platforms to establish people-oriented migration policy

International climate law can also make an important contribution to regulating climate-induced migration and generates increasing attention to the phenomenon. Although neither the Framework Convention on Climate Change (UNFCCC, 1992) nor the Paris Agreement of 2015 (UNFCCC, 2015) contain regulations on climate-change-related migration, since the 16th Conference of the Parties in Cancún in 2010, migration has been recognized as an adaptation strategy. The Warsaw Mechanism for Loss and Damage also addresses the topic and is setting up a Task Force on Displacement on behalf of the Parties (UNFCCC, undated). The WBGU recommends using the framework of the UNFCCC to establish the climate passport.

The climate passport for *just & in-time* migration

Inspired by the humanitarian innovation of the Nansen passport, the climate passport aims to create early, liberal and dignified migration options in the sense of a *just & in-time* transformation for people who are existentially threatened by climate change. At the 24th Climate Change Conference in Katowice in December 2018, Germany's Federal Government – as a pioneer of potential host countries – should propose the climate passport as an offer to the populations of low-lying island states. Particularly countries with high historical and current emissions and the affected island states should accede to a corresponding UNFCCC protocol (e.g. to the Paris Agreement). The climate passport would not only serve as a humanitarian instrument that makes migration possible as an adaptation strategy; it should also be understood as compensation for climate-related loss and damage.

Recommendation

Create the climate passport as a strong, multilateral instrument that opens up early, voluntary and dignified migration options

The inhabitants of low-lying island states should take priority and be the first to benefit from the climate passport. These states deserve to be given special attention in context of the *just & in-time* transformation. The scientific evidence that they are especially severely affected is unequivocal (Box 6). In extreme cases the topography allows no retreat within their own territory or via a connection to the mainland. Within the framework of the Alliance of Small Island States (AOSIS) and the Climate Vulnerable Forum the countries are showing an exemplary political commitment to rapid decarbonization in the sense of common but differentiated responsibility. In the medium term, the climate passport should also be used to offer a dignified and safe migration option to residents of other states that are existentially threatened by changes in the climate – particularly to the large number of internally displaced persons.

This in no way undermines the urgent need for climate-change-mitigation measures or the sovereignty of the island states, because the climate passport would be established and financed not instead of, but concomitantly with climate-change-mitigation and physical adaptation measures. Affected individuals should be able to decide freely whether and when they would like to migrate using safe and early migration options. In this case, the decision to migrate would thus not be suddenly forced on them or taken with no alternative, but would, in a best-case scenario, be one of a number of adaptation options. The WBGU recommends identifying individual (groups of) island states that are objectively especially threatened by the potential loss of their territory with the help of a scientific commission and using the expertise of the Intergovernmental Panel on Climate Change (IPCC). Their inhabitants would then be entitled to a climate passport without any complex, individual testing.

Additional, targeted measures should be taken between the Parties to the protocol covering the period before and after an individual's decision to migrate to ensure that vulnerable migrants in particular do not also

face a precarious existence in the host countries (Adger et al., 2014). In this context, guidelines should also recognize and address non-economic losses such as cultural and social disruption (Serdeczny, 2017).

In order to ensure a fair regulation of climate-induced migration, the WBGU stresses the key role of the polluter-pays principle (Principle 16 Rio Declaration; WBGU, 2008, 2009). It should form the basis for deciding which nations should accept people with a climate passport. Countries whose emissions make a major contribution to climate change should offer opportunities for, and rights to, a dignified future for those who have suffered existential loss. These countries bear a considerable responsibility for the causes of migration by people harmed by climate change and should be the first to take on obligations to grant entry options to the bearers of the climate passport.

Should states take the view that accepting climate-induced migrants involves an excessive burden, this will also give them a greater incentive to be more ambitious in reducing emissions and thus themselves help combat the long-term causes of displacement and migration.

A pragmatic system for identifying host countries could take into account both cumulative, historical emissions and current per-capita emissions. Under such a system, potential candidates might include the ten countries or groups of countries with the highest absolute shares of cumulative CO₂ emissions (Figure 3), and the 15 countries or groups of countries with the highest current per-capita emissions from their respective territory (Table 1). This simple identification strategy can be linked with other categories, such as the gross

Table 1

The 15 states with currently (2014) the highest annual per-capita CO₂ emissions. They are currently making a disproportionately high contribution to the further increase in atmospheric CO₂ concentration and therefore have a special responsibility when climate-related migrants lose their homes.

Source: based on World Bank, 2014

Country	Emissions in 2014 [t CO ₂ per capita]
Qatar	45.5
Curaçao	37.7
Trinidad and Tobago	34.2
Kuwait	25.2
Bahrain	23.4
United Arab Emirates	23.3
Brunei Darussalam	22.1
Saudi Arabia	19.5
Sint Maarten (Dutch part)	19.5
Luxembourg	17.4
United States of America	16.5
New Caledonia	16.0
Gibraltar	15.5
Oman	15.4
Australia	15.4

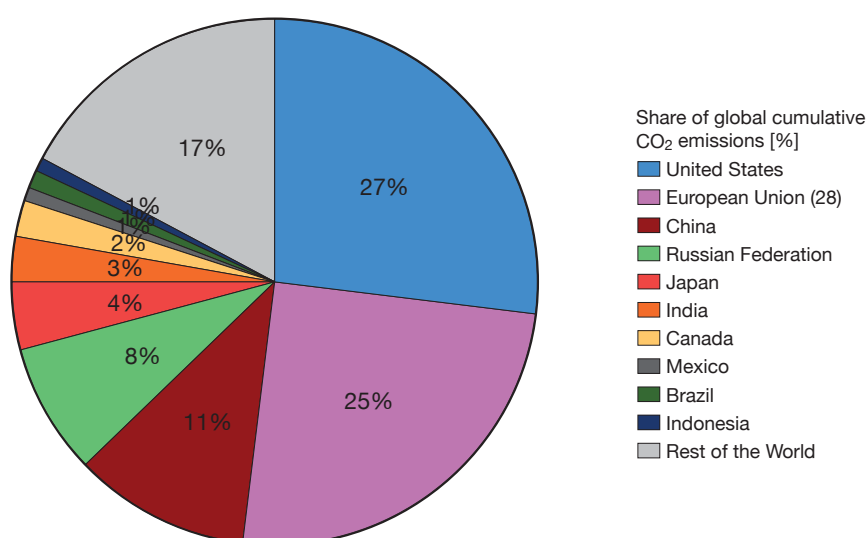


Figure 3

The ten states or groups of states with the highest shares of global cumulative CO₂ emissions (1850–2011). They have a particular responsibility for climate change and thus also when climate-related migrants lose their homes. Source: WRI, 2014

domestic product of the host countries, their surface area or population density. In addition, countries with less responsibility for climate change are encouraged to recognize the climate passport and grant migrants dignified immigration options.

The German Federal Government can meet important international obligations and commitments by supporting the climate passport. Voluntary and preventive migration is regarded as an important field of action by the multilateral Platform on Disaster Displacement, which cooperates closely with the UN's migration and refugee institutions (PDP, 2018). Similarly, the Multistakeholder Agenda for Humanity, which was adopted in 2016 and supported by Germany, requires states to open up more legal migration pathways and make humanitarian visas available (World Humanitarian Summit, 2016).

Last, but not least, the climate passport would serve as a kind of 'beacon of humanity', counteracting the current moral race to the bottom in the treatment of migrants. As a cornerstone of a *just & in-time* transformation, it can help implement the Agenda 2030 and not leave anyone behind, despite existential loss and destruction.

Promote *just & in-time* structural change with transformation funds

In Article 2 of the Paris Agreement, the Parties undertook to make “finance flows consistent with a pathway towards low greenhouse-gas emissions and climate-resilient development.” As early as 2016, the WBGU proposed the establishment of transformation funds in the G20 countries, stating that their structure, investment strategy and use of returns should be geared to the requirements of a transformation towards sustainability and thus also be in line with low-carbon development (WBGU, 2016a). The present paper takes up this recommendation again and refines it with respect to the *just & in-time* perspective introduced here. These yet-to-be-created transformation funds serve a *just & in-time* transformation in more ways than one. They are financed by a comprehensive greenhouse-gas-emissions pricing scheme (GHG pricing) based on the ‘polluter pays’ principle, and invest these funds in sustainable business models and infrastructure to avoid causing harm to future generations through climate change. Furthermore, the current returns from these investments are used to finance measures to support those affected by structural adaptation processes triggered by the transformation (Figure 4).

Socially balanced structural change requires considerable financial resources. In the EU, the additional annual financing requirement for a low-carbon energy infrastructure that is in line with the goals of the Paris Agreement is estimated at €180 billion per year up to 2030 (EU HLEG, 2018:37). The OECD expects additional global investments of US\$600 billion per year (2015) to be needed up to 2030 (OECD, 2017:102) to have a 66% chance of limiting climate change to 2°C. The financing requirement for a *just & in-time* transformation is likely to be far higher if it also recognizes the adaptation challenges of population groups, regions and countries affected by the move away from fossil resources and provides social- and structural-policy support. The WBGU regards consistent, preferably international GHG pricing, supplemented by revenues from an estate tax, as a promising approach, since it already takes key justice-related considerations (such as the polluter-pays principle) into account at the stage of collecting public contributions to the transformation fund.

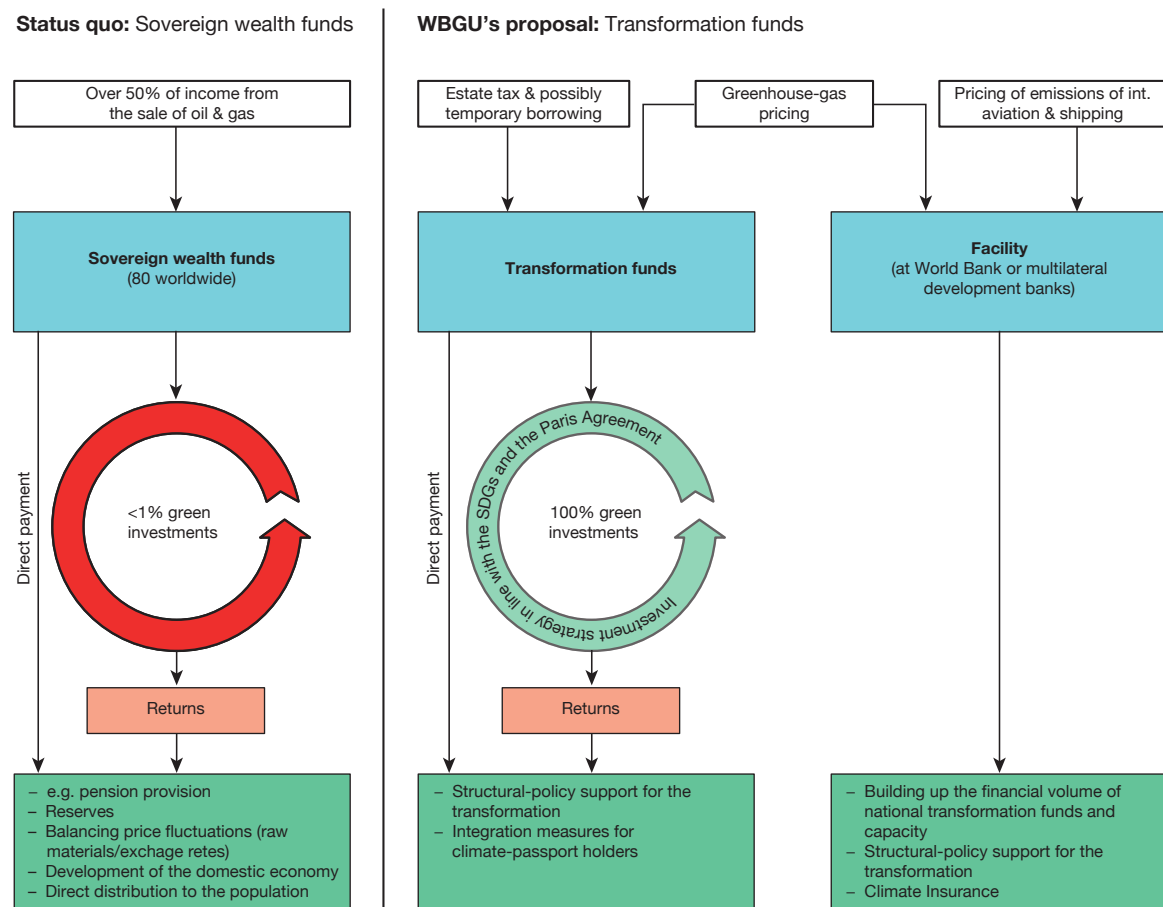
Since countries with higher levels of economic cap-

acity as a rule bear greater historical responsibility for emissions, economically weaker countries should receive support in coping with structural adaptation processes. Based on their experience and specific knowledge in the financing of structural aid, the WBGU regards the World Bank and regional development banks as particularly well-suited for enabling affected countries to independently customize structural change in the medium to long term. Therefore, the WBGU recommends that countries with high levels of economic capacity pay a portion of their revenue from GHG pricing into a facility serving countries that do not have the capacity to build up their own funds and tackle structural adaptation processes.

Transformation funds as a tool for setting up a *just & in-time* transformation

When institutionally embedded at the nation-state level, a transformation fund is in essence a sovereign wealth fund whose investment strategy and use of returns are geared towards the requirements of the transformation of economic and societal systems in the course of decarbonization and sustainable development. According to the Sovereign Wealth Funds Institute, there are currently 80 sovereign wealth funds administering a financial volume of approx. US\$7,900 billion (SWFI, 2018). They pursue different macroeconomic and financial objectives. Up to now, however, financing and designing climate-friendly structural change has rarely been among them (Box 7). According to current estimates, green investments account for less than 1% of sovereign wealth funds’ total investment volume (UNEP, 2018).

In order to do justice to the different funding requirements of a *just & in-time* transformation, the WBGU recommends setting up national, i.e. country-specific transformation funds. Existing sovereign wealth funds should be used much more than in the past to finance and provide social-policy support for decarbonization. This has already been considered in a first step by the One Planet Sovereign Wealth Fund Working Group (Box 7).

**Figure 4**

The WBGU's proposal for transformation funds (right) to finance and implement a *just & in-time* transformation. The transformation funds should be geared towards the needs of a transformation towards sustainability when building up their financial volume and in terms of their investment strategy and use of returns. The volume of the transformation funds should be built up by pricing greenhouse-gas emissions, supplemented by revenue from a reformed inheritance or estate tax. Furthermore, countries with high levels of economic capacity should pay a portion of their revenue from GHG pricing into a facility serving countries that do not have sufficient means to build up their own funds or to tackle structural adaptation processes. This revenue could be complemented by pricing emissions from international aviation and maritime transport. The transformation funds should pursue an investment strategy in line with the SDGs and the Paris Agreement and could therefore be a model for existing sovereign wealth funds (left) in terms of the realignment of financial flows. In order to create legitimacy for decarbonization and to do justice to the debate on a just transition, the returns from the transformation funds' investments should be used in particular to provide social- and structural-policy support for the transformation.

Source: WBGU

Such transformation funds would be independent institutions. Although they would have to report periodically to a parliamentary supervisory body, they would on principle be free to identify suitable investment objects, both nationally and internationally, on their own initiative. This would make it possible to largely separate the financing of socially balanced structural change from the often short-term political interests involved in budget negotiations. This greater independence promises advantages, especially in the case of long-

term projects and objectives. It makes state climate policy more dependable, thus creating planning security; this in turn supports farther-reaching private economic initiatives for decarbonizing the economy and society (L  w-Beer et al., 2018). In the case of an international investment strategy, financing via a transformation fund can furthermore help stabilize a country's financial leeway in climate and structural policy, for example vis-  -vis national economic fluctuations.

Box 7

Sustainability focus of existing sovereign wealth funds

Sovereign wealth funds are investors oriented towards long-term objectives. Therefore, there is a growing discussion on the role that existing sovereign wealth funds could play in the financing of climate-change mitigation and sustainable development (Sharma 2017; World Bank, 2018). Up to now, sovereign wealth funds have made only very limited sustainable investments. However, the sovereign wealth funds themselves are showing a growing interest in the implications of climate change and in the possibilities of investing in climate-change mitigation, not least for reasons of risk diversification and concerns about financial losses due to so-called stranded assets or climate-induced damage. Up to now, sovereign wealth funds in Norway, New Zealand and France in particular have been seen

as pioneers of climate-friendly investment (UNEP, 2018). Another example worthy of note in this context is the One Planet Sovereign Wealth Fund Working Group, a group of five of the largest sovereign wealth funds (including funds from the oil-rich countries of the Middle East) and the New Zealand government funds; it was founded in the context of the One Planet Summit in Paris and currently has a total investment volume of about US\$3,000 billion (IFSWF, 2018). The group recently published its first guidelines and recommendations on how sovereign wealth funds should deal in their investment strategies with the challenges of decarbonization and the threat of climate change, and how they should behave as company shareholders (SWF, 2018). This initiative is to be welcomed in principle as a first step, although the guidelines are still rather general and non-binding, and no links have hitherto been created to the alleviation of the effects of structural change and climate-related damage.

Recommendation

All countries: set up transformation funds that are geared towards a *just & in-time* transformation in their funding, investment strategy and use of returns

Investment strategy

The investment activity of the proposed transformation funds should aim to drive forward a transformation of the economy and society that is oriented towards sustainability and climate-change-mitigation goals. In their investment activities, the transformation funds should support decarbonization and sustainable development in areas where private-sector markets cannot secure sufficient funding – even after a system of taxes and charges that is consistently oriented towards climate-change-mitigation objectives has been introduced. This focus on funding gaps ensures that the investments of the transformation funds do not displace private-sector investments and thus impede appropriate private-sector participation in the costs and risks of decarbonization. For a variety of reasons, funding gaps are to be expected in the necessarily profound and long-term restructuring of the economy in the course of decarbonization. The maturity structure of the investment required often exceeds the time horizons of private companies, or else their societal value added is underestimated by private-sector actors. Furthermore,

private investors can face systemic risks and coordination problems, e.g. if the success of a technology or measure depends on the parallel development of a corresponding infrastructure (Euribor, 2014; Altenburg and Rodrik, 2017).

Accordingly, the investment activities of transformation funds could include the (co-)funding of infrastructure, e.g. in the fields of mobility and energy-supply systems. Other possibilities might be investments and holdings in industries that are key to the implementation of climate-change-mitigation and sustainability goals, for example in innovative energy technologies. As a shareholder, the transformation fund can also lobby for the inclusion of its long-term goals in corporate decisions. The commitment of such an investor, reliably oriented towards the long-term objectives of climate-change mitigation, could also send out a signal and lead to more private financial flows being geared towards sustainability and climate-change mitigation objectives. Last, but not least, the investments of a transformation fund can reduce risks for private investors due to their explicit orientation towards long-term goals, e.g. in the case of investments in young, innovative companies.

Both in the sense of risk diversification and in the sense of international balance, a transformation fund should not follow a country-specific, but an international investment strategy. Possible strategic dependencies, especially in the case of economically weaker countries, should be avoided. Instead, even potential investments in infrastructure should be designed in such a way that they primarily help others to help themselves.

The proposed transformation funds aim to make a contribution to closing funding gaps; however, they cannot and should not replace the involvement of private-sector actors. To also encourage private actors to contribute more to decarbonization and sustainable

development through their investment activities, in the course of decarbonization professional investors should pay more attention to the systemic risks of climate change and structural adaptations in their investment decisions. In addition to initiatives like the Task Force on Climate-related Financial Disclosures, which was initiated in 2015 by the Financial Stability Board and makes practical recommendations on the disclosure of climate-related financial risks (TCFD, 2017), more fundamental research efforts are needed to improve the process of assessing climate-related risks to investments.

In the context of an interdisciplinary research programme, therefore, the existing indicators and definitions of sustainable financing instruments should be developed further with the participation of climate and financial experts. This would also help assess and compensate for positive externalities of sustainable investments (G20 Green Finance Study Group, 2016). Since existing estimates of the financing volume, such as the above-mentioned studies by EU HLEG (2018) and OECD (2017), do not take into account the cost of tackling social adaptation challenges, the WBGU recommends continuing to assess the global financing volume involved in a *just & in-time* transformation that also considers social issues and equity questions.

Use of current returns

The necessary profound restructuring of the economy and infrastructure and the move away from fossil resources will inevitably lead to losses of jobs and value added in individual economic sectors in the short to medium term. This topic was examined in an illustrative way above with the example of the coal phase-out, stressing that a *just & in-time* form of transformation must also recognize and, wherever possible, politically address these losses and adaptation challenges. It should involve professional supervision of structural change by a Zero Carbon Mission, as well as financial support to reduce social risks to the people affected, make them more forward looking, and strengthen their capabilities and ability to act. The current returns of the transformation funds should be made available for this purpose. In addition, it would be conceivable, for instance, to finance measures to integrate climate passport holders, for whom the greater independence of the transformation funds from day-to-day political disputes should be beneficial.

Since, during the transformation funds' development phase, the current returns would probably be lower than the financing requirements, a certain proportion of the financial volume of the funds could be used directly for structural and social-policy support.

Building up the financial volume

The process of raising the funds to build up the financial volume of the transformation funds should already be geared towards the goal of a *just & in-time* transformation. In this respect, a transformation fund differs significantly from existing sovereign wealth funds, which still derive more than 50% of their income from the sale of fossil resources (SWFI, 2018; UNEP, 2018). Institutionalized sources of revenue are necessary in order to maintain the independence of the transformation fund from day-to-day political developments and to develop reliable long-term financing structures. Consistent pricing of greenhouse-gas emissions should be introduced as the main instrument for building up a transformation fund. This would take into account the 'polluter pays' principle. Furthermore, in this way the process of raising financial resources would already be linked to the goals of climate-change mitigation, since such a pricing scheme exerts a strong steering effect on private-sector investment and consumption decisions, as well as on research and development targeting decarbonization (High-Level Commission on Carbon Prices, 2017). At the same time, substantial financial resources could be generated with comprehensive GHG pricing, at least in industrialized countries and emerging economies. For Germany, the WBGU estimates the average revenue from CO₂ pricing at an average of €18 billion per year for the period between 2020 and 2050, based on a CO₂ price of US\$30 in 2020 and a subsequent doubling of the price after each decade (WBGU, 2016a).

Depending on the expected financing requirements to be covered via a transformation fund, an analysis can be made to determine whether and to what extent all the revenue from GHG pricing should be used to fill the fund, or whether part of the revenue should be transferred to the current budget to cover other societal or socio-political expenditures. Furthermore, due to the strong steering effect on private-sector investment, the countries that have already established sovereign wealth funds – and are accordingly not necessarily dependent on the revenue from GHG pricing to build up a fund – should also consistently gear their tax and levy systems to climate-policy objectives. If, as in the case of Germany, there are (constitutional or other) legal reasons against a direct transfer of the revenue from GHG pricing to a transformation fund, a counter-financing model could be considered. In this model, the revenue from GHG pricing initially flows into the government budget, and the state undertakes to transfer financial resources from there to the fund.

When drafting the GHG pricing system, from an economic point of view an internationally coordinated approach is preferable, although this could hardly be implemented in the short term within the framework of

the Paris Agreement. For this reason, the initial focus should be on tax and emissions-trading systems at the national level or in a relatively small group of countries. A successive, bottom-up regional expansion of the systems is desirable, but it must not be seen as a prerequisite for the introduction of greenhouse-gas prices. Germany should play a pioneering role in this context.

In the long term, an internationally coordinated approach to GHG pricing can, however, offer advantages not only from an economic point of view, but also for reasons of equity. For example, a transnational – let alone global – emissions-trading system would generate considerable flows of funds into economically weaker regions if states auctioned certificates to emitters, e.g. on the basis of a per-capita allocation of internationally agreed emission targets. This would open up a direct source for filling transformation funds for economically weaker countries, most of which bear less historical responsibility for emissions. Transferring the income into a transformation fund in such a system would mitigate fluctuations in trading revenues caused by volatile certificate prices, and stabilize the countries' financial room for manoeuvre (Jakob et al., 2015).

Recommendation

All countries: use GHG pricing, supplemented by a reformed inheritance or estate tax, to build up transformation funds

However, financing requirements already can be high during the fund's start-up phase, e.g. for social policy support in the light of structural change. A temporary loan could be considered in such a case. Such a supplement to the revenue from GHG pricing can defuse the possible conflict of interest between short-term funding requirements and sustainable investments geared towards long-term returns, and in particular prevent the selection of investment objects on the basis of their short-term profitability rather than their long-term societal value. Reasons of intergenerational justice (and timeliness) can also justify borrowing if the loan serves to initiate the necessary transformation earlier. The higher costs of transformation at the expense of future generations could be avoided in this way, e.g. by means of a steadier restructuring of economic and societal sys-

tems. Should the shaping of a *just & in-time* transformation require more financial resources in the longer term, or if new objectives are added over time to the sustainability agenda (Box 8) which exceed the financial scope of the transformation fund based on GHG pricing, then a reformed inheritance or estate tax can provide permanent access to additional resources. For Germany, the WBGU estimates revenues from a 10% estate tax at approx. €20 billion per year (WBGU, 2016a). As in the case of GHG pricing, revenues from an estate tax would be linked to the principles of equity. Since the accumulation of wealth cannot be detached from the respective societal context, the redirection of inherited assets for the promotion of the common good seems justified (Atkinson, 2016; Beckert, 2004). Favourable overall economic conditions for wealth creation in today's industrialized countries were not least the result of using fossil energy sources as a driver of economic growth. To this extent, earmarking part of estate tax for climate-change mitigation to create a decarbonized economy and mitigate the consequences of structural adaptations can also be seen as accepting historical responsibility. The conversion of existing sovereign wealth funds that were built up by selling fossil resources into transformation funds can be justified in a similar way.

While ongoing decarbonization puts an upper limit on the cash inflow from GHG pricing, a permanent supplementary source of finance like an estate tax means that there is no longer a cap on the fund's volume in the long term. In view of the uncertainties in relation to the overall financing needs of transformation, cited as an example at the beginning (Fankhauser et al., 2016; Peake and Ekins, 2017), and possible new objectives on the sustainability agenda (Box 8), a decision as to whether and when the fund's volume should be capped can also be left to future generations. However, the disadvantages and potential dangers of increasing public involvement in financial markets should also be borne in mind in this context.

Pursuing European solutions

Within a more integrated group of countries with existing supranational institutions and structural-policy programmes like the EU, a transnational approach to setting up a transformation fund can be an advantage. This applies in particular in the context of a coordinated approach to GHG pricing and supporting the regions affected by structural change. Against this background, the WBGU advocates setting up a transformation fund as a common institution at the EU level, perhaps, initially, in a smaller group of EU countries. Various initiatives at the EU level are already pointing in the direction of a European transformation fund to finance a European 'just transition'. For example, in the course of the

Box 8**Long-term goals of the transformation funds**

Transformation funds are conceptually designed to support the implementation of key tasks for the future and sustainable development. The SDGs and the Paris Agreement now provide an internationally agreed system of goals. In the course of time, however, it cannot be ruled out that new topics will find their way onto the sustainability agenda. The question therefore arises as to whether the transformation fund's volume should be successively used up in the course of the implementation of the SDGs and complete decarbonization, or whether a fund's long-term objectives and tasks should be adapted or expanded on the basis of new challenges, for example in the course of ongoing digitalization.

Taking the specific example of digitalization, fundamental structural changes in the economic and societal system are emerging which, with the help of a transformation fund, could be made more sustainable. As in the context of decarbonization, the fund, as a shareholder, could use its influence on

internal corporate decisions to place more emphasis on societal interests and values. This role could become particularly relevant in companies that are increasingly exercising quasi-public functions by providing digital services and data records, such as digital platforms, for example.

Another topic increasingly being discussed in the course of digitalization is the future of work and a potential risk of social division in societies (ILO, 2017). Against this background, several authors have already considered the possibility of using holdings in companies and platforms for distributive objectives in the future. The transformation fund's revenues could be paid out to the citizens, thus distributing corporate profits and capital gains more broadly throughout society (Corneo, 2015; Horn et al., 2017; Löw-Beer et al., 2018; Sönke and Haarlack, 2017; Fratzscher, 2018). In Alaska, for example, the returns from the Alaska Permanent Fund (APFC, 2018) are used to pay out an unconditional basic income. Should similar models for securing the existence of broad sections of the population become necessary in the future, existing transformation funds, funded by the pricing of GHG emissions, could reduce the ensuing acute financing needs.

discussions held in February 2017 on the adaptation of the EU ETS to the Paris climate goals, EU parliamentarians supported the idea of using the proceeds from the auctioning of emission certificates to set up a Just Transition Fund with the aim of cushioning the labour-market effects of decarbonization (European Parliament, 2017). Furthermore, the need for profound changes in the financial system towards sustainability was highlighted at the EU level (EU HLEG, 2018). In March, the European Commission submitted a strategy for a sustainable financial system in Europe, whose aim is to gear capital flows towards a more sustainable economy (European Commission, 2018a). It should also be noted that a harmonized approach to the pricing of CO₂ emissions already exists at the EU level: the EU ETS, which currently covers 45% of European greenhouse-gas emissions (European Commission, 2018b).

A European transformation fund could link up with the EU's existing structural funds and thus have recourse to many years of experience in European structural policy, which is already promoting regions with structural problems and low levels of development (e.g. European Regional Development Fund). A European transformation fund would set itself apart from these existing structural-policy instruments through its clearer focus on the decarbonization of the European economy and society and the associated structural adaptation challenges. As already mentioned, this approach also reduces the risk of private investment being directly crowded out; there are signs of this with the existing structural funds (Breidenbach et al., 2016). In addition, the transformation fund would operate as an internationally active investor.

Supporting structural adaptation processes in economically weaker countries

Not all countries currently seem to have the economic or institutional preconditions for setting up and running a transformation fund in the longer term. In the WBGU's view, industrialized countries should provide economically less powerful countries with support in tackling decarbonization and alleviating the social repercussions of structural change, partly because of their historical responsibility for climate change. In the sense of helping people to help themselves (capacity building), however, the aim of this support should be to enable the countries concerned to design the necessary structural changes independently via their own transformation funds in the medium to long term.

In the WBGU's view, the World Bank and regional (multilateral) development banks are suitable institutions for implementing this multilateral support. The World Bank and development banks have many years of experience in designing and managing long-term financing mechanisms. They also initiated and accompanied over long periods processes of structural change in developing countries and emerging economies, which means they have the necessary local expertise. Furthermore, they are already fully involved in financing measures for climate-change mitigation and adaptation to climate change in developing countries and emerging economies (OECD, 2017). In 2016 alone, multilateral development banks provided a total of US\$27.4 billion in financial support, mobilizing several times this amount in additional (private) funding (MDB, 2017). The comparatively young Asian Infrastructure Investment Bank has set itself the goal of financing energy and transport

infrastructure in line with the climate-change-mitigation goals of the Paris Agreement in the Asian region (AIIB, 2017); it contributed US\$465 million to financing renewable energies in 2016. The same applies to the also newly established New Development Bank, which invested US\$511 million in the development of renewable energies in 2016 and aims to direct 60% of its total lending to renewable energies (Buchner et al., 2017:4).

The special role of development banks was recently also underlined at the One Planet Summit in Paris, where more than 30 public development banks committed themselves to giving even stronger support to the Paris climate goals (IDFC-MDB, undated). In addition to their activities hitherto, which lay mainly in the areas of (co-)funding new energy technologies, expanding and developing infrastructure, and strengthening the climate resilience of societies, the development banks should in future also focus more systematically on the monitoring and social support of structural change and on considering the situation of possible losers. In order to support countries without sufficient capacity to build up their own funds and tackle the structural adaptation processes, a new facility should be set up (e.g. at the World Bank) to bundle existing programmes that is funded by part of the revenue from GHG pricing.

Earmarking at least part of revenue from pricing emissions from international aviation and maritime transport could serve as an additional source of funding. Emissions from international aviation and shipping have hitherto been largely excluded from climate-policy regulations. Although flights within the EU have been covered by the EU emissions-trading system since 2012, more than half of all aviation emissions are generated over international territory (Becken and Mackey, 2017). Under the umbrella of the International Civil Aviation Organization (ICAO), an offsetting obligation has been agreed on for air carriers over this international territory which applies to emissions that exceed the average for 2019 and 2020 (CORSIA). It covers all flights between states that have voluntarily acceded to the agreement in the first two introductory phases up to 2026, or that will be obliged to take part from 2027 on the basis of their share of global aviation emissions. Currently (in June 2018), 72 states have agreed to participate (voluntarily), so that approx. 76% of international air transport emissions will be covered (ICAO, 2016). Although this step is to be welcomed in principle, establishing an emissions-neutral growth of air traffic does not contribute to the goal of reducing global CO₂ emissions to zero by about the middle of the century. Not even such a comparatively weak regulation exists to date for international shipping.

Recommendation

Create a facility at the World Bank or multilateral development banks to support countries without sufficient capacity to build up their own funds and tackle structural change

In order to price emissions by international aviation and shipping, not only the level of emissions taxation should be unequivocally and internationally clarified, but also particularly the allocation of emissions from international transport movements to the respective countries; this has been controversial up to now. In the WBGU's view, such a complex international procedure should be sought, although it will most likely require long coordination and negotiation processes. Therefore, in the meantime, in order not to slow down and endanger the necessary rapid structural change, industrialized countries like Germany in particular should meet their commitment to international support and reserve parts of their revenue from the recommended GHG pricing in other sectors for these purposes.

It should also be noted that the necessary support for a *just & in-time* transformation in individual countries goes beyond funding structural change and related social-support measures. Another subject for discussion should on principle be how to deal with the threat of asset losses as a result of climate change, e.g. as a result of floods or droughts caused by climate change. Financial and organizational support can be provided in the form of insurance solutions, particularly in areas where, for various reasons, the private sector has been unable to develop them. Although insurance solutions do not represent a separate financing approach, they would, above all, reduce the risk of high, short-term financing requirements for the World Bank and the regional development banks, if multilateral compensation for climate-change-related damage were also organized by these institutions (Durand et al., 2016; Richards and Schalteck, 2017).

The issue of possible compensation for climate-related damage is most urgent for island states, where impending losses will mean the permanent and complete loss of their state territory to a rise in the sea level (Box 6). If it proves impossible to prevent these extreme scenarios, the primarily structural considerations mentioned up to now will clearly no longer be enough to

justify using international aid to set up transformation funds for these states as an element of *just & in-time* climate policy. However, the funds could then complement the climate passport and be allocated to preserving the national heritage and cultural goods of the countries concerned.

References

- Adger, N. M., Pulhin, J. M., Barnett, J., Dabelko, G. D., Hovelsrud, G. K., Levy, M., Oswald Spring, Ú. and Vogel, C. H. (2014): Human security. In: Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T. E., Chatterjee, M., Ebi, K. L., Estrada, Y. O., Genova, R. C., Girma, B., Kissel, E. S., Levy, A. N., MacCracken, S., Mastrandrea, P. R. and White, L. L. (eds): *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, New York: Cambridge University Press, 755–791.
- African Union (2009): *African Union Convention for the Protection and Assistance of Internally Displaced Persons in Africa (Kampala Convention)*. Kampala: African Union.
- AIIB – Asian Infrastructure Investment Bank (2017): *Energy Sector Strategy: Sustainable Energy for Asia*. Internet: <https://www.aiib.org/en/policies-strategies/strategies/sustainable-energy-asia/index.html>. Beijing: AIIB.
- Alcántara, S., Kuhn, R., Renn, O., Bach, N., Böhm, B., Dienel, H., Ullrich, P., Schröder, C. and Walk, H. (2014): *DELIKAT-Fachdialoge Deliberative Demokratie: Analyse Partizipativer Verfahren für den Transformationsprozess*. Dessau: German Federal Environment Agency (UBA).
- Aldrich, D. P. and Meyer, M. A. (2015): Social capital and community resilience. *American Behavioral Scientist* 59 (9), 254–269.
- Altenburg, T. and Rodrik, D. (2017): Green industrial policy: accelerating structural change towards wealthy green economies. In: Altenburg, T. and Assmann, C. (eds): *Green Industrial Policy: Concept, Policies, Country Experiences*. Geneva: German Development Institute and Partnership for Action on Green Economy, 1–25.
- Andersen, L. R. and Björkman, T. (2017): *The Nordic Secret. A Story of Beauty and Freedom*. Stockholm: fri tanke.
- AOSIS – Alliance of Small Island States (2017): *Urgency of Now Declaration of Action*. Internet: <http://aosis.org/aosis-adopts-urgency-of-now-declaration-of-action/>. New York, Geneva: AOSIS.
- APFC – Alaska Permanent Fund Corporation (2018): *The Permanent Fund*. Internet: <https://apfc.org/who-we-are/a-pioneering-investment-model>. Juneau, AK: APFC.
- Asheim, B. T., Boschma, R. and Cooke, P. (2011): Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies* 45 (7), 893–904.
- Atkinson, A. B. (2016): *Ungleichheit. Was wir dagegen tun können*. Stuttgart: Klett Cotta.
- Baasch, S. and Blöbaum, A. (2017): Umweltbezogene Partizipation als gesellschaftliche und methodische Herausforderung. *Partizipation im Umweltkontext. Umweltpsychologie* 41 (2), 1–164.
- Bals, C., Schäfer, L. and Künzel, V. (2018): *The Significance of Climate Litigation for the Political Debate on Loss & Damage*. Bonn: Germanwatch.
- Bamberg, S., Reese, J. and Seebaer, S. (2015): Collective climate action: Determinants of participation intention in community-based pro-environmental initiatives. *Journal of Environmental Psychology* 43, 155–165.
- Bandura, A. (1977): Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review* 84, 191–215.
- Becken, S. and Mackey, B. (2017): What role for offsetting aviation greenhouse gas emissions in a deep-cut carbon world? *Journal of Air Transport Management* 63, 71–83.
- Beckert, J. (2004): *Unverdientes Vermögen: Soziologie des Erbrechts*. Reihe Theorie und Gesellschaft. Frankfurt/M.: Campus.
- Black, R., Arnell, N. W., Adger, W. N., Thomas, D. and Geddes, A. (2013): Migration, immobility and displacement outcomes following extreme events. *Environmental Science & Policy* 27, S32–S43.
- Boom, K., Richards, J.-A. and Leonard, S. (2016): *Climate Justice. The International Momentum Towards Climate Litigation*. Berlin: Heinrich Böll Foundation.
- Breakwell, G. M. (1986): *Coping with threatened identities*. Psychology Press 5, 1–222.
- Breidenbach, P., Mitze, T. and Schmidt, C. M. (2016): *EU Structural Funds and Regional Income Convergence –*

- A Sobering Experience. Discussion Paper 11210. London: Centre for Economic Policy Research (CEPR).
- Brouers, C. (2012): Der Schutz der Umwelt- und Klimaflüchtlinge im Völkerrecht: Regelungslücken und Lösungsansätze. *Zeitschrift für Umweltrecht* 81, 81–89.
- Buchner, B. K., Oliver, P., Wang, X., Carswell, C., Meattle, C. and Mazza, F. (2017): Climate Policy Initiative – Global Landscape of Climate Finance 2017. San Francisco, London: Climate Policy Initiative (CPI).
- Campbell, S. and Coenen, L. (2017): Transitioning Beyond Coal: Lessons from the Structural Renewal of Europe's Old Industrial Regions. CCEP Working Paper 1709. Melbourne: CCEP.
- Chen, X., Zhang, X., Church, J. A., Watson, C. S., King, M. A., Monselesan, D., Legresy, B. and Harig, C. (2017): The increasing rate of global mean sea-level rise during 1993–2014. *Nature Climate Change* 7, 492.
- Ciais, P., Sabine, C., Bala, G., Bopp, L., Brovkin, V., Canadell, J., Chhabra, A., DeFried, R., Galloway, J., Heimann, M., Jones, C., Le Quéré, C., Myneni, R., Piao, S. and Thornton, P. (2013): Carbon and other biogeochemical cycles. In: Stocker, T. F., Qin, D. and Plattner, G.-K. (eds): *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, MA: Cambridge University Press, 467–544.
- Corneo, G. (2015): Inequality, Public Wealth, and the Federal Shareholder. Discussion Paper Series 10920. London: Centre for Economic Policy Research.
- Coumou, D., Robinson, A. and Rahmstorf, S. (2013): Global increase in record-breaking monthly-mean temperatures. *Climatic Change* 118 (3), 771–782.
- Davenport, C. (2015): The Marshall Islands Are Disappearing. Rising Seas are Claiming a Vulnerable Nation. Internet: <https://www.nytimes.com/interactive/2015/12/02/world/The-Marshall-Islands-Are-Disappearing.html>. New York: New York Times Online.
- DeConto, R. M. and Pollard, D. (2016): Contribution of Antarctica to past and future sea-level rise. *Nature* 531, 591.
- Dienel, P. C. (2002): *Die Planungszelle. Der Bürger als Chance*. Opladen: Westdeutscher Verlag.
- Dienel, P. C. (2009): *Demokratisch, praktisch, gut: Merkmale, Wirkungen und Perspektiven der Planungszelle*. Bonn: Dietz.
- Durand, A., Hoffmeister, V., Weikmans, R., Gewirtzman, J. and Natson, S. (2016): *Financing Options for Loss and Damage: a Review and Roadmap*. Bonn: German Development Institute.
- EU HLEG – European Union High-Level Expert Group on Sustainable Finance (2018): *Financing a Sustainable European Economy. Final Report 2018*. Brussels: EU High-Level Expert Group.
- EURACOAL – European Association for Coal and Lignite (2017): *Coal Industry Across Europe: 6th Edition With Insights*. Brussels: EURACOAL.
- European Commission (2012): *Guide to Research and Innovation Strategies for Smart Specialisations (RIS 3)*. Brussels: European Commission.
- European Commission (2018a): *Action Plan: Financing Sustainable Growth*. COM(2018) 97 final. Brussels: European Commission.
- European Commission (2018b): *EU Emissions Trading System (EU ETS)*. Internet: https://ec.europa.eu/clima/policies/ets_en. Brussels: European Commission.
- European Parliament (2017): *MEPs Back Plans to Cut Carbon Emission Allowances and Fund Low-Carbon Innovation*. Internet: <http://www.europarl.europa.eu/news/en/press-room/20170210IPR61806/meps-back-plans-to-cut-carbon-emission-allowances-and-fund-low-carbon-innovation>. Brussels: European Parliament.
- Fankhauser, S., Sahni, A., Savvas, A. and Ward, J. (2016): Where are the gaps in climate finance? *Climate and Development* 8 (3), 203–206.
- Ferris, E. and Bergmann, J. (2017): Soft law, migration and climate change governance. *Journal of Human Rights and the Environment* 8 (1), 6–29.
- Fiddian-Qasmiyeh, E., Loescher, G., Long, K. and Sigona, N. (2014): *The Oxford Handbook of Refugee and Forced Migration Studies*. Oxford, New York: Oxford University Press.
- Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A. and Rahmstorf, S. (2017): Three years to safeguard our climate. *Nature* 546 (7660), 593–595.
- Foray, D. (2014): *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy*. London: Routledge.
- Foresight (2011): *Migration and Global Environmental Change: Future Challenges and Opportunities. Final Project Report*. London: UK Government Office for Science.

- Fratzscher, M. (2018): Warum zahlt uns Google nicht eine Nutzungsgebühr? Eine Kolumne. Internet: <https://www.zeit.de/wirtschaft/2018-02/digitalisierung-vermoegen-staatsfonds-soziale-teilhabe-ungleichheit>. Hamburg: Die Zeit Online.
- Fromhold-Eisebith, M. (2012): From exit to excellence: turning old industry regions into knowledge regions through triple helix processes. In: van Geenhuizen, M. and Nijkamp, P. (eds): *Creative Knowledge Cities. Myths, Visions and Realities*. Cheltenham: Edward Elgar, 182–209.
- Ganswindt, K., Rötters, S. and Schücking, H. (2013): *Bitter Coal: Ein Dossier über Deutschlands Steinkohleimporte*. Cologne: FIAN Deutschland, urgewald.
- Germanwatch (2018): Fragen und Antworten zum Fall Huaraz. Internet: <https://germanwatch.org/de/14577>. Berlin: Germanwatch.
- Gesang, B. (2014): *Kann Demokratie Nachhaltigkeit?* Wiesbaden: Springer VS.
- Gewirtzman, J., Natson, S., Richards, J.-A., Hoffmeister, V., Durand, A., Weikmans, R., Huq, S. and Roberts, J. T. (2018): Financing loss and damage: reviewing options under the Warsaw International Mechanism. *Climate Policy* doi.org/10.1080/14693062.2018.1450724, 1–11.
- Goch, S. (2002): Eine Region im Kampf mit dem Strukturwandel. Bewältigung von Strukturwandel und Strukturpolitik im Ruhrgebiet. Essen: Klartext.
- Grabher, G. (1993): The weakness of strong ties; the lock-in of regional development in the Ruhr area. In: Grabher, G. (eds): *The Embedded Firm: On the Socioeconomics of Industrial Networks*. London: Routledge, 255–277.
- G20 Green Finance Study Group (2016): *G20 Green Finance Synthesis Report*. Toronto: G20 Green Finance Study Group.
- Hague District Court (2015): *Urgenda Foundation vs. The Netherlands*. Case No.: C/09/456689 / HA ZA 13-1396. The Hague: The Hague District Court. Chamber for Commercial Affairs.
- Hanschel, D. (2017): Klimaflüchtlinge und das Völkerrecht. *Zeitschrift für Ausländerrecht und Ausländerpolitik* 1, 1–8.
- Hassink, R. (2010): Locked in decline? On the role of regional lock-ins in old industrial areas. In: Boschma, R. and Martin, R. (eds): *Handbook of Evolutionary Economic Geography*. Cheltenham: Edward Elgar, 450–468.
- Heinze, R. G., Helle, E., Hilbert, J., Nordhause-Janzen, J., Nowak, N., Potratz, W. and Scharfenorth, K. (2013): *Strukturpolitik zwischen Tradition und Innovation – NRW im Wandel*. Heidelberg, Berlin: Springer.
- Herring, S. C., Christidis, N., Hoell, A., Kossin III, James P. and Stott, P. A. (2018): Explaining extreme events of 2016 from a climate perspective. *Bulletin of the American Meteorological Society (Special Supplement)* 99 (1), 1–13.
- Heyen, D. A., Hermwille, L. and Wehnert, T. (2017): Out of the comfort zone! Governing the exnovation of unsustainable technologies and practices. *GAIA* (4), 326–331.
- High Court Lahore (2015): *Ashgar Leghari vs. Federation of Pakistan*. Climate Change Order. Case No: W. P. No. 25501/2015. Lahore: Lahore High Court Lahore Judicial Department.
- High-Level Commission on Carbon Prices (2017): *Report of the High-Level Commission on Carbon Prices*. Washington, DC: World Bank Publications.
- Hobfoll, S. E. (1989): Conservation of resources: a new attempt at conceptualizing stress. *American Psychologist* 44 (3), 513–524.
- Hobfoll, S. E., Freedy, J., Lane, C. and Geller, P. (1990): Conservation of social resources: Social support resource theory. *Journal of Social and Personal Relationships* 7 (4), 465–478.
- Horelli, L. (2002): A methodology of participatory planning. In: Bechtel, R. B. and Curchman, A. (eds): *Handbook of Environmental Psychology*. New York: Wiley, 607–628.
- Horn, G. A., Behringer, J., Gechert, S., Rietzler, K. and Stein, U. (2017): *Was tun gegen die Ungleichheit? Wirtschaftspolitische Vorschläge für eine reduzierte Ungleichheit*. Frankfurt/M.: Hans Böckler Foundation.
- Huffman, A. H., Culbertson, S. S., Wayment, H. A. and Irving, L. H. (2015): Resource replacement and psychological well-being during unemployment: The role of family support. *Journal of Vocational Behavior* 89, 74–82.
- ICAO – International Civil Aviation Organization (2016): *CORSIA States for Chapter 3 State Pairs*. Internet: <https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx>. Montreal: ICAO.
- IDFC-MDB – International Development Finance Club - Multilateral Development Banks (o.J.): Joint IDFC-

- MDB Statement. Together Major Development Finance Institutions Align Financial Flows With the Paris Agreement Paris: IDFC-MDB.
- IDMC – Internal Displacement Monitoring Centre and NRC – Norwegian Refugee Council (2017): GRID 2017. Global Report on Internal Displacement. Geneva: IDMC.
- IFSWF – International Forum of Sovereign Wealth Funds (2018): One Planet SWF Working Group Publish Framework on Climate Change. Internet: <http://www.ifswf.org/general-news/one-planet-swf-working-group-publish-framework-climate-change>. London: IFSWF.
- ILO – International Labour Organization (2017): The Future of Work We Want: A Global Dialogue. Geneva: ILO.
- Imada, Y., Shiogama, H., Takahashi, C., Watanabe, M., Mori, M., Kamae, Y. and Maeda, S. (2018): Climate change increased the likelihood of the 2016 heat extremes in Asia. *Bulletin of the American Meteorological Society* 99 (1), 97–101.
- Ionesco, D., Mokhnacheva, D. and Gemenne, F. (2017): The Atlas of Environmental Migration. London, New York: International Organization for Migration.
- IPCC – Intergovernmental Panel on Climate Change (2014): Climate Change 2014: Impacts, Adaptation, and Vulnerability. Geneva: IPCC.
- IPCC – Intergovernmental Panel on Climate Change (2015): Climate Change 2014. Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.
- ITUC – International Trade Union Confederation (2015): Climate Justice: There Are no Jobs on a Dead Planet. Frontlines Briefing. Geneva: ITUC.
- ITUC-CSI – International Trade Union Confederation - Confédération Syndicale Internationale (2017): Just Transition. A Report for the OECD. Geneva: ITUC.
- Jahoda, M. (1982): Employment and Unemployment: A Social-Psychological Analysis. Cambridge, MA: Cambridge University Press.
- Jakob, M., Steckel, J. C., Flachsland, C. and Baumstark, L. (2015): Climate finance for developing country mitigation: blessing or curse? *Climate and Development* 7 (1), 1–15.
- Jellinek, G. (1914): Allgemeine Staatslehre. 3. Auflage. Berlin, Häring.
- Johnson, C. (2016): Holding polluting countries to account for climate change: is “Loss and Damage” up to the task? Review of Policy Research doi.org/10.1111/ropr.12216.
- Kälin, W. (2017): Klimaflüchtlinge oder Katastrophenvertriebene. *German Review on the United Nations* 65 (5), 207–212.
- Kelley, C. P., Mohtadi, S., Cane, M. A., Seager, R. and Kushnir, Y. (2015): Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences* 112 (11), 3241–3246.
- Kelley, C., Mohtadi, S., Cane, M., Seager, R. and Kushnir, Y. (2017): Commentary on the Syria case: Climate as a contributing factor. *Political Geography* 30, 1e3.
- Kelman, I. (2015): Difficult decisions: migration from small island developing states under climate change. *Earth's Future* 3 (4), 133–142.
- King, A. D. and Harrington, L. J. (2018): The inequality of climate change from 1.5 to 2°C of global warming. *Geophysical Research Letters* 45 (10), 5030–5033.
- Knutson, T. R., Kam, J., Zeng, F. and Wittenberg, A. T. (2018): Cmp5 Model-based assessment of anthropogenic influence on record global warmth during 2016. *Bulletin of the American Meteorological Society* 99 (1), 11–15.
- Koschätzky, K. (2018): Innovation-Based Regional Structural Change: Theoretical Reflections, Empirical Findings and Political Implications. Working Papers Firms and Regions No. R1. Karlsruhe: Fraunhofer ISI.
- Landgericht Essen (2016): Störerhaftung eines Energiekonzerns: Kostentragungspflicht für Schutzmaßnahmen vor einer durch Treibhausgasemissionen entstehenden Gletscherflut in Peru. Aktenzeichen: 2 O 285/15. Urteil. Essen: Landgericht.
- Lazarus, R. S. (1993): From psychological stress to the emotions: a history of changing outlooks. *Annual Review of Psychology* 44 (1), 1–22.
- Le Club des Juristes (2017): Toward a Global Pact for the Environment. White Paper. Paris: Le Club des Juristes.
- Leggewie, C. and Nanz, P. (2016): Die Konsultative. Berlin: Wagenbach.

- Le Quéré, C., Andrew, R. M., Friedlingstein, P., Sitch, S., Pongratz, J., Manning, A. C., Korsbakken, J. I., Peters, G. P., Canadell, J. G., Jackson, R. B., Boden, T. A., Tans, P. P., Andrews, O. D., Arora, V. K., Bakker, D. C. E., Barbero, L., Becker, M., Betts, R. A., Bopp, L., Chevallier, F., Chini, L. P., Ciais, P., Cosca, C. E., Cross, J., Currie, K., Gasser, T., Harris, I., Hauck, J., Haverd, V., Houghton, R. A., Hunt, C. W., Hurtt, G., Ilyina, T., Jain, A. K., Kato, E., Kautz, M., Keeling, R. F., Klein Goldewijk, K., Körtzinger, A., Landschützer, P., Lefèvre, N., Lenton, A., Lienert, S., Lima, I., Lombardozzi, D., Metzl, N., Millero, F., Monteiro, P. M. S., Munro, D. R., Nabel, J. E. M. S., Nakaoka, S. I., Nojiri, Y., Padin, X. A., Peregon, A., Pfeil, B., Pierrot, D., Poulter, B., Rehder, G., Reimer, J., Rödenbeck, C., Schwinger, J., Séférian, R., Skjelvan, I., Stocker, B. D., Tian, H., Tilbrook, B., Tubiello, F. N., van der Laan-Luijkx, I. T., van der Werf, G. R., van Heuven, S., Viovy, N., Vuichard, N., Walker, A. P., Watson, A. J., Wiltshire, A. J., Zaehle, S. and Zhu, D. (2018): Global Carbon Budget 2017. *Earth System Science Data* 10 (1), 405–448.
- Lietzmann, H. J., Dankwart-Kammoun, S. and Freier, A. N. (2017): Das partizipative Reallabor – Gestalten Bürger ihre Energiewende? In: Sommer, J. (eds): *Kursbuch Bürgerbeteiligung*. Norderstedt: Books on Demand, 487–505.
- Lilleør, H. and van den Broeck, K. (2011): Economic drivers of migration and climate change in LDCs. *Global Environmental Change* 21 (Supplement 1), S70–S81.
- Löw-Beer, D., Schlüter, T., Vinke, K. and Schellnhuber, H. J. (2018): Transformationsfonds für die Nachhaltigkeitswende. *Leviathan* (in publication).
- Manning, P. and Trimmer, T. (2013): *Migration in World History*. London, New York: Routledge.
- Marrus, M. R. (2013): Nansen-Pass. In: Diner, D. (eds): *Enzyklopädie jüdischer Geschichte und Kultur* 44. Stuttgart, Weimar: Metzler, 313–315.
- Matthies, E. and Blöbaum, A. (2008): Partizipative Verfahren und Mediation. In: Lantermann, E.-D. and Linneweber, V. (eds): *Grundlagen, Paradigmen und Methoden der Umweltpsychologie*. Göttingen: Hogrefe, 811–837.
- McAdam, J. (2014): *Climate Change, Forced Migration, and International Law*. New York, Oxford University Press.
- McNamara, K. E. (2015): Cross-border migration with dignity in Kiribati. *Forced Migration Review* 49, 62ff.
- MDB – Multilateral Development Banks (2017): *Joint Report on Multilateral Development Banks' Climate Finance*. London: European Bank for Reconstruction and Development (EBRD).
- Mengel, M., Nauels, A., Rogelj, J. and Schleussner, C.-F. (2018): Committed sea-level rise under the Paris Agreement and the legacy of delayed mitigation action. *Nature Communications* 9 (1), 601.
- Molitoris, M. (2004): Tabakprozesse in den USA, Deutschland und anderen europäischen Ländern. *Neue juristische Wochenschrift*, 3662–3670.
- Morgan, K. (2017): Nurturing novelty: regional innovation policy in the age of smart specialisation. *Environment and Planning C: Politics and Space* 35 (4), 569–583.
- Moulaert, F. and Sekia, F. (2003): Territorial innovation models: a critical survey. *Regional Studies* 37 (3), 289–302.
- Müller, B., Haase, M., Kreienbrink, A. and Schmid, S. (2012): Klimamigration – Definitionen, Ausmaß und politische Instrumente in der Diskussion. Working Paper 45 der Forschungsgruppe des Bundesamtes. Nürnberg: Bundesamt für Migration und Flüchtlinge.
- Neftel, A., Moor, E., Oeschger, H. and Stauffer, B. (1985): Evidence from polar ice cores for the increase in atmospheric CO₂ in the past two centuries. *Nature* 315, 45.
- Nerem, R. S., Beckley, B. D., Fasullo, J. T., Hamlington, B. D., Masters, D. and Mitchum, G. T. (2018): Climate-change-driven accelerated sea-level rise detected in the altimeter era. *Proceedings of the National Academy of Sciences* 115 (9), 2022–2025.
- Nicholls, R. J., Marinova, N., Lowe, J. A., Brown, S., Vellinga, P., de Gusmão, D., Hinkel, J. and Tol, R. S. J. (2011): Sea-level rise and its possible impacts given a 'beyond 4°C world' in the twenty-first century. *Philosophical Transactions of the Royal Society A* 369 (1934), 161–181.
- Nümann, B. (2014): Umweltflüchtlinge? Umweltbedingte Personenbewegungen im Internationalen Flüchtlingsrecht. Baden-Baden: Nomos.
- Nümann, B. (2015): Kein Flüchtlingschutz für "Klimaflüchtlinge". *Zeitschrift für Ausländerrecht und Ausländerpolitik*, 165–172.
- Nurse, L. A., McLean, R. F., Agard, J., Briguglio, L. P., Duvat-Magnan, V., Pelesikoti, N., Tompkins, E. and Webb, A. (2014): Small islands. In: Barros, V. R., Field, C. B., Dokken, D. J., Mastrandrea, M. D., Mach, K. J., Bilir, T.

- E., Chatterjee, M., Ebi, K. L., Estrada, Y. O., Genova, R. C., Girma, B., Kissel, E. S., Levy, A. N., MacCracken, S., Mastrandrea, P. R. and White, L. L. (eds): *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, New York: Cambridge University Press, 1613–1654.
- Oberlandesgericht Hamm (2017): *Rechtsstreit Lliuya ./. RWE AG*. Pressemitteilung. Hamm: Oberlandesgericht.
- OECD – Organisation for Economic Co-operation and Development (2017): *Investing in Climate, Investing in Growth*. Paris: OECD.
- Oliver-Smith, A. and de Sherbinin, A. (2014): *Resettlement in the twenty-first century*. *Forced Migration Review* 45, 23–25.
- Oppenheimer, M. and Alley, R. B. (2016): How high will the seas rise? *Science* 354 (6318), 1375–1377.
- Paul, L. A., Price, M., Gros, D. F., Gros, K. S., McCauley, J. L., Resnick, H. S., Acerno, R. and Ruggiero, K. J. (2014): The associations between loss and posttraumatic stress and depressive symptoms following Hurricane Ike. *Journal of Clinical Psychology* 70 (4), 322–332.
- Paul, K. I. and Moser, K. (2009): Unemployment impairs mental health: meta-analyses. *Journal of Vocational behavior* 74 (3), 264–282.
- PDP – Platform on Disaster Displacement (2018): *Enhance the Use of Identified Effective Practices*. Internet: <https://disasterdisplacement.org/enhance-the-use-of-identified-effective-practices>. Geneva: PDP.
- PDP – Platform on Disaster Displacement (undated): *Homepage der Platform on Disaster Displacement*. Internet: <https://disasterdisplacement.org>. Geneva: International Environment House.
- Peake, S. and Ekins, P. (2017): Exploring the financial and investment implications of the Paris Agreement. *Climate Policy* 17 (7), 832–852.
- People's Climate Case (2018): *Legal Summary of the People's Climate Case*. Berlin: People's Climate Case.
- Renn, O., Wachinger, G., Kinn, U. and Altendorf-Bayha, U. (2011): Lessons Learned aus Stuttgart 21. *Bürgermitwirkung bei Planungs- und Bauprojekten. Spektrum der Mediation* 42, 4–11.
- Renn, O. and Webler, T. (1998): Der kooperative Diskurs – Theoretische Grundlagen, Anforderungen, Möglichkeiten. *Analyse & Kritik* 18, 175–207.
- Richards, J.-A. and Schalatek, L. (2017): *Financing Loss and Damage: A Look at Governance and Implementation Options – A Discussion Paper*. Washington, DC: Heinrich Böll Foundation North America.
- Rigaud, K. K., Sherbinin, A. D., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., McCusker, B., Heuser, S. and Midgley, A. (2018): *Groundswell – Preparing for Internal Climate Migration*. Washington, DC: World Bank.
- Rockström, J., Gaffney, O., Rogelj, J., Meinshausen, M., Nakicenovic, N. and Schellnhuber, H. J. (2017): A roadmap for rapid decarbonization. *Science* 355 (6331), 1269–1271.
- Rodrik, D. (2014): Green industrial policy. *Oxford Review of Economic Policy* 30 (3), 469–491.
- Rogelj, J., Luderer, G., Pietzcker, R. C., Kriegler, E., Schaeffer, M., Krey, V. and Riahi, K. (2015): Energy system transformations for limiting end-of-century warming to below 1.5°C. *Nature Climate Change* 5, 519–527.
- Rose, M. (2018): *Zukünftige Generationen in der heutigen Demokratie. Theorie und Praxis der Proxy-Repräsentation*. Heidelberg, Berlin: Springer.
- Ryder, G. (2014): There are No Jobs on a Dead Planet. Internet: <https://iloblog.org/2014/10/08/there-are-no-jobs-on-a-dead-planet>. Geneva: International Labour Organization Blog.
- Sabin Center for Climate Change Law and Kanzlei Arnold & Porter (undated): *Climate Case Chart*. Internet: <http://climatecasechart.com>. New York, NY: Sabin Center for Climate Change Law, Kanzlei Arnold & Porter.
- Sands, P., Peel, J., Fabra, A. and Mackenzie, R. (2018): *Principles of Environmental Law*. Cambridge, New York: Cambridge University Press.
- Schulz, S. and Schwartzkopff, J. (2017): Strukturpolitik in den deutschen Kohleregionen. *Das Neue fest im Blick. Politische Ökologie* 149, 106–112.
- Serdeczny, O. (2017): What Does It Mean To “Address Displacement” Under the UNFCCC? Discussion Paper No. 12. Bonn: German Development Institute.
- Sharma, R. (2017): *Sovereign Wealth Funds Investment in Sustainable Development Sectors*. New York: United Nations High-Level Conference on Financing for Development and the Means of Implementation of the 2030 Agenda for Sustainable Development.
- Shindell, D., Faluvegi, G., Seltzer, K. and Hindell, C. (2018): Quantified, localized health benefits of accelerated

- carbon dioxide emissions reductions. *Nature Climate Change* 8, 291–295.
- Sobel, A. H., Camargo, S. J., Hall, T. M., Lee, C. Y., Tippet, M. K. and Wing, A. A. (2016): Human influence on tropical cyclone intensity. *Science* 353 (6296), 242–246.
- Sönke, T. and Haarlack, A. (2017): Ein Staatsfonds für Deutschland? Grundüberlegungen und internationale Vorbilder. Gütersloh: Bertelsmann Stiftung.
- Statistik der Kohlenwirtschaft (2017a): Braunkohle: Beschäftigte im Braunkohlenbergbau nach Revieren ab 1929. Internet: <https://kohlenstatistik.de/19-0-Braunkohle.html>. Essen: Statistik der Kohlenwirtschaft e.V.
- Statistik der Kohlenwirtschaft (2017b): Steinkohle: Gesamtbelegschaft nach Revieren ab 1945. Internet: <https://kohlenstatistik.de/18-0-Steinkohle.html>. Essen: Statistik der Kohlenwirtschaft e.V.
- Steckel, J. and Jakob, M. (2018): The role of financing cost and de-risking strategies for clean energy investment. *International Economics* doi.org/10.1016/j.inteco.2018.02.003, in appearance.
- Stern, N. (2006): *Stern Review on the Economics of Climate Change*. London: Her Majesty's Treasury.
- Storlazzi, C. D., Gingerich, S. B., van Dongeren, A., Cheriton, O. M., Swarzenski, P. W., Quataert, E., Voss, C. I., Field, D. W., Annamalai, H. and Piniak, G. A. (2018): Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances* 4 (4), 1–9.
- SWF – Sovereign Wealth Fund (2018): *The One Planet Sovereign Wealth Fund Framework*. London: SWF.
- SWFI – Sovereign Wealth Fund Institute (2018): *Sovereign Wealth Fund Rankings. Largest Sovereign Wealth Funds by Assets Under Management*. Internet: <https://www.swfinstitute.org/sovereign-wealth-fund-rankings>. Seattle, WA: SWFI.
- TCFD – Task Force on Climate-Related Financial Disclosures (2017): *Recommendations of the Task Force on Climate-Related Financial Disclosures. Final Report*. Basel: TCFD.
- Thies, J. (2017): *Evian 1938. Als die Welt die Juden verriet*. Essen: Klartext Verlag.
- Tversky, A. and Kahneman, D. (1981): The framing of decisions and the psychology of choice. *Science* 211 (4481), 453–458.
- UN – United Nations (2018): *Global Compact for Safe, Orderly and Regular Migration. Final Draft*. New York: UN.
- UNEP – United Nations Environment Programme (2017): *Klimawandel vor Gericht. Ein globaler Überblick*. Nairobi: UNEP.
- UNEP – United Nations Environment Programme (2018): *The Role of Sovereign Wealth Funds for Green Investment. Policy Brief – Financing the SDGs*. Nairobi: UNEP.
- UNFCCC – United Nations Framework Convention on Climate Change (undated): *Task Force on Displacement*. Internet: <https://unfccc.int/wim-excom/sub-groups/TFD>. Bonn: UNFCCC Secretariat.
- UNFCCC – United Nations Framework Convention on Climate Change (1992): *United Nations Framework Convention on Climate Change. FCCC/INFORMAL/84*. Internet: Bonn: UNFCCC Secretariat.
- UNFCCC – United Nations Framework Convention on Climate Change (2015): *Adoption of the Paris Agreement. FCCC/CP/2015/L.9/Rev.1*. Bonn: UNFCCC Secretariat.
- UNGA – UN General Assembly (2016): *New York Declaration for Refugees and Migrants. Resolution Adopted by the General Assembly on 19 September 2016*. New York: UNGA.
- United States Court of Appeals for the Ninth Circuit (2012): *Native Village of Kivalina v. EXXONMobil*. Internet: <http://climatecasechart.com/case/native-village-of-kivalina-v-exxonmobil-corp>. San Francisco, CA: United States Court of Appeals for the Ninth Circuit.
- United States District Court Southern District of New York (2018): *Complaint: City of New York vs. BP P.L.C.; Vhecvron Corporation; ConocoPhillips; Exxon Mobil Corporation; Royal Dutch Shell P.L.C.* Case 1:18-cv-00182-JFK. New York: United States District Court Southern District of New York.
- UNODC – United Nations Office on Drugs and Crime (2016): *Global Study on Legal Aid. Global Report*. New York: UNODC.
- van Vuuren, D. P., Stehfest, E., Gernaat, D. E. H. J., Berg, M., Bijl, D. L., Boer, H. S., Daioglou, V., Doelman, J. C., Edelenbosch, O. Y. and Harmsen, M. (2018): Alternative pathways to the 1.5°C target reduce the need for negative emission technologies. *Nature Climate Change* 8, 391–397.
- Vinke, K., Schellnhuber, H. J., Coumou, D., Geiger, T., Glanemann, N., Huber, V., Kropp, J., Kriewald, S., Lehmann, J., Levermann, A., Lobanova, A., Knaus, M., Otto, C., Reyer, C., Robinson, A., Rybski, D., Schewe, J., Willner, S., Wortmann, M., Zhao, F., Zhou, B., Laplante, B., Lu, X. and Rodgers, C. (2017): *A Region at Risk. The Human Dimensions of Climate Change in Asia and the Pacific*. Manila, Philippines: Asian Development Bank (ADB).

- Wang, U. (2018): What Oil Companies Knew About Climate Change and When: A Timeline. Internet: <https://www.climateliabilitynews.org/2018/04/05/climate-change-oil-companies-knew-shell-exxon>. New York: Climate Liability News Online.
- Warner, K. (2011): Climate Change Induced Displacement: Adaptation Policy in the Context of the UNFCCC Climate Negotiations. Geneva: United Nations High Commissioner for Refugees (UNHCR).
- WBGU – German Advisory Council on Global Change (2008): World in Transition: Climate Change as a Security Risk. Flagship Report. London: Earthscan.
- WBGU – German Advisory Council on Global Change (2009): Solving the climate dilemma: The budget approach. Special Report. Berlin: WBGU.
- WBGU – German Advisory Council on Global Change (2011): World in Transition – A Social Contract for Sustainability. Flagship Report. Berlin: WBGU.
- WBGU – German Advisory Council on Global Change (2014): Climate Protection as a World Citizen Movement. Special Report. Berlin: WBGU.
- WBGU – German Advisory Council on Global Change (2016a): Development and justice through transformation: The Four Big 'I's. Special Report. Berlin: WBGU.
- WBGU – German Advisory Council on Global Change (2016b): Humanity on the move: Unlocking the transformative power of cities. Flagship Report. Berlin: WBGU.
- Weber, E. U. (2006): Experience-based and description-based perceptions of long-term risk: why global warming does not scare us (yet). *Climatic Change* 77 (1–2), 103–120.
- Weir, T., Dovey, L. and Orcherton, D. (2017): Social and cultural issues raised by climate change in Pacific Island countries: an overview. *Regional Environmental Change* 17 (4), 1017–1028.
- Wiek, A., Ness, B., Schweizer-Ries, P. and Farioli, F. (2014): Collaboration for transformation. *Sustainability Science* 9 (1), 113–114.
- WMO – World Meteorological Organization (2018): WMO Statement on the State of the Global Climate in 2017. Geneva: WMO.
- World Bank (2014): CO₂ emissions (metric tons per capita). Internet: <https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>. Washington, DC: World Bank.
- World Bank (2018): Sovereign Wealth Funds: The Catalyst for Climate Finance? Internet: <http://blogs.worldbank.org/psd/health/sovereign-wealth-funds-catalyst-climate-finance>. Washington, DC: World Bank Online.
- World Humanitarian Summit (2016): Agenda for Humanity. Annex to the Report of the Secretary-General for the World Humanitarian Summit (A/70/709). New York: United Nations (UN).
- WRI – World Resources Institute (2014): 6 Graphs Explain the World's Top 10 Emitters. Internet: <http://www.wri.org/blog/2014/11/6-graphs-explain-world%E2%80%99s-top-10-emitters>. Washington, DC: WRI.
- Zinnöcker, T. (2017): Nachhaltigkeit, Energiewende und Digitalisierung. In: Hildebrandt, A. and Landhäußer, W. (eds): CSR und Digitalisierung. Der digitale Wandel als Chance und Herausforderung für Wirtschaft und Gesellschaft. Berlin: Springer Gabler, 201–208.

Authors

Lead authors: Martina Fromhold-Eisebith, Ulrike Grote, Ellen Matthies, Dirk Messner, Karen Pittel, Hans Joachim Schellnhuber, Ina Schieferdecker, Sabine Schlacke, Uwe Schneidewind

Co-authors: Katharina Bohnenberger, Nele Degener, Marcel J. Dorsch, Marian Feist, Juliana Gärtner, Maja Göpel, Ulrike Jürschik, Carsten Loose, Reinhard Messerschmidt, Johannes Pfeiffer, Benno Pilardeaux, Teresa Schlüter, Astrid Schulz, Paul Szabo-Müller, Hannah Wallis, Nora Wegener

Recommended citation

WBGU – German Advisory Council on Global Change (2018): *Just & In-Time Climate Policy. Four Initiatives for a Fair Transformation.* Policy Paper 9. Berlin: WBGU.

Acknowledgments

The Advisory Council would like to thank all those who have contributed valuable suggestions on the policy paper through conversations, comments and advice.

Dr. Maria Martin, Kira Vinke (Potsdam Institute for Climate Impact Research – PIK), Timon Wehnert (Wuppertal Institute for Climate, Environment and Energy)

Research analysts

Dr. Maja Göpel (Secretary-General), Dr. Carsten Loose (Deputy Secretary-General), Katharina Bohnenberger, M.A. (Wuppertal Institute for Climate, Environment and Energy), Nele Degener, MSc (Leibniz University Hannover), Marcel J. Dorsch, M.A. Dipl.-Päd. (Univ.) (WBGU Secretariat, Berlin), Marian Feist, PhD (German Development Institute – DIE, Bonn), Juliana Gärtner, M.Phil. (Potsdam Institute for Climate Impact Research – PIK), Ulrike Jürschik, Dipl.-Jur. (Institute for Environmental Law and Planning Law – IUP, Münster), Reinhard Messerschmidt, M.A. (WBGU Secretariat, Berlin), Dr. Johannes Pfeiffer (Ifo Center for Energy, Climate and Exhaustible Resources, Munich), Dr. Benno Pilardeaux (WBGU Secretariat, Berlin), Dr. Teresa Schlüter (WBGU Secretariat, Berlin), Dr. Astrid Schulz (WBGU Secretariat, Berlin), Paul Szabo-Müller, M.A. (Department of Geography at RWTH Aachen University), Dr. Hannah Wallis (Otto-von-Guericke-University Magdeburg), Nora Wegener, M.A. (Fraunhofer Institute for Open Communication Systems – FOKUS, Berlin).

The R&D project that generated this report was conducted on behalf of the German Federal Ministry of Education and Research and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety under grant number 01RIO708A4. Responsibility for the content of this publication rests with the author.

The Council Members

Prof Dirk Messner (Chair)

Director of the German Development Institute (DIE), Bonn and Co-Director of the Center for Advanced Studies on Global Cooperation Research, University of Duisburg-Essen

Prof Sabine Schlacke (Chair)

Professor of public law, executive director of the Institute for Environmental Law and Planning Law, University of Münster

Prof Martina Fromhold-Eisebith

Chair of Economic Geography, Department of Geography at RWTH Aachen University

Prof Ulrike Grote

Director of the Institute for Environmental Economics and World Trade at Leibniz University of Hannover and Senior Fellow at Center for Development Research (ZEF), Bonn

Prof Ellen Matthies

Professor for Environmental Psychology, Otto-von-Guericke-University Magdeburg

Prof Karen Pittel

Director of the Ifo Center for Energy, Climate and Exhaustible Resources and Professor of Economics, esp. Energy, Climate and Exhaustible Natural Resources, Faculty of Economics, University of Munich

Prof Hans Joachim Schellnhuber CBE

Director of the Potsdam Institute for Climate Impact Research (PIK), Professor for Theoretical Physics and elected Member of the Pontifical Academy of Sciences

Prof Ina Schieferdecker

Director of Fraunhofer Institute for Open Communication Systems (FOKUS) in Berlin, Professor for Quality Engineering of Open Distributed Systems at TU Berlin and Founding Director of Weizenbaum Institute for the Networked Society

Prof Uwe Schneidewind

President and Chief Research Executive of the Wuppertal Institute for Climate, Environment and Energy; Professor for Sustainable Transition Management at the University of Wuppertal

German Advisory Council on Global Change

WBGU Sekretariat Phone: +49 30 26 39 48-0
Luisenstraße 46 Email: wbg@wbg.de
D-10117 Berlin Internet: www.wbg.de
 @WBGU_Council

Copy deadline 20.07.2018

This policy paper is available online in German and English.

Translation: Bob Culverhouse, Berlin

2018, WBGU ISBN 978-3-936191-86-8

