Cornerstones and positions of a precautionary post-growth economy[1]

The end of the growth-based model of prosperity

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Environmental crises are increasingly acute. Particularly prominent in the public debate is the climate crisis. The increases in greenhouse gas concentrations in the atmosphere is only one particularly striking anthropogenic intervention in the ecosystems (see Bindoff/Stott/AchutaRao et al. 2013: 869). Humanity has already put other fundamental earth system processes in a critical condition. Thus, for instance, the global volumes of phosphorus and nitrogen entering soils and water bodies have also exceeded critical limits (see Rockström/Steffen/Noon et al. 2009a/b, Steffen/Richardson/Rockström et al. 2015). Less prominent in the public debate is the biodiversity crisis (see IPBES 2019). These developments threaten future generations with drastic and irreversible disadvantages. In contrast to 'traditional' industrial environmental pollution, which can at least to a certain extent be 'filtered out' (and relocated) using add-on technologies, these 'new' challenges are closely linked to our way of life and economic model, which are based on economic growth.

Particularly in the early industrialised countries, this model has undoubtedly contributed towards welfare gains, reflected for instance in greater life expectancy. Globally speaking, in particular the catch-up devel-

1 This article is based on a study undertaken for the German Federal Environmental Agency (*Umweltbundesamt*) (Petschow/aus dem Moore/Pissarskoi et al. 2018), which was conducted by the Institute for Ecological Economic Research (*Institut für ökologische Wirtschaftsforschung*) and the RWI Leibniz Institute for Economic Research (*RWI Institut für Wirtschaftsforschung*). It is available for free download on the Federal Environmental Agency website.

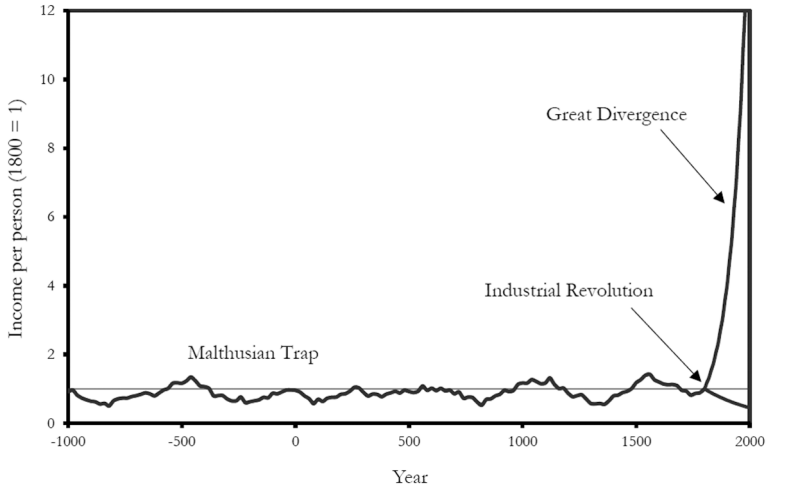
opment of China and the dramatic economic growth associated with it have led to a clear reduction in poverty rates. There is thus little controversy about the positive correlation between economic development and social well-being. However, questions are increasingly being asked about whether and to what extent future generations will ultimately have to pay for these gains.

The early industrialised, prosperous countries are responsible for a disproportionately high share of the impacts on natural systems (in relation to greenhouse gas emissions (GHG-emissions) see Caney 2009: 126). This article therefore focuses on the following questions: What role is played by economic performance and its future development in more prosperous countries like Germany with relation to adhering to planetary boundaries? What (environment) policy implications arise from this? We address these questions by introducing the historical and current growth debates, providing an overview of prominent positions and undertaking a critical analysis that allows us to derive a new proposal: the precautionary post-growth position, which we present for discussion.

Growth and welfare discussions

The discussion about economic growth and growth limits was long neglected in economic discourses, receiving attention mostly from 'outsiders'. Thus, in his essay 'The economics of the coming spaceship earth', Kenneth Boulding (1966) firstly referred to a metaphor popular at the time, that of 'Spaceship Earth', and secondly pointed out the significance of limits (also of the substitutability of factors of production). The first report on 'The limits to growth' by Meadows et al. (1972) led to considerable discussion, even if the possibility of substitution was certainly underestimated in detail. Georgescu-Roegen (1987), and also his pupil Daly (1977), called for other economic models. Consideration of these 'early' warnings underlines that it took the recent changes in the social and media climate at the end of the 2010s to bring sufficient pressure to bear and enable the issue of growth to be addressed again.

Figure 1: Global development of income over time



Source: Clark 2007

At least in the long term, economic growth has not in any way been a constant of human development but is rather closely linked to the industrial revolution (Clark 2007). It was the industrial revolution that enabled escape from the 'Malthusian trap'.[2] The special European path emerged not (only) due to the development of technology, but also due to the social conditions that determined whether and how this technology was used.[3] In this vein, Mokyr (2016) highlights the cultural conditions of this social change ("culture of growth") and focuses particularly on fundamental beliefs, suggesting that the transformation of the belief system was primarily linked to perceptions of nature. In combination with the specific contexts in Europe (competition between smaller states or cities) and the emergence of networks (in science and engineering), this transformation was ultimately decisive for the industrial revolution. McCloskey (2016) suggests that it was not the

2 Malthus (1803) analysed the relationship between population growth and crop yields. He suggested that population growth occurs in geometric progression while food production increases in arithmetic progression so that there is a natural ceiling due to limits on possible increases in food production. This, according to Malthus, makes economic growth almost impossible (Clark 2007, Fertig/Pfister 2012).

3 As seen in the inventions that were well-known in China but did not lead to similar economic growth.

available energy resources, the innovations of the nineteenth century or the emergence of market institutions that were decisive, as all these factors also existed in other regions. She rather assumes that cultural factors and ideas were key, for instance the emergence of the natural sciences and the 'Republic of Letters' (Mokyr 2016) and thus the development of scientific networks. Denzau and North (1994) also refer to the role played by ideas and institutions in social change. It hence becomes clear that both economic historians and institutional economists see ideas and guiding principles as playing an essential role in economic development. These findings are also relevant for the sustainability discussion, as illustrated by Meyerhoff und Petschow (1996).

The increase in per capita income that occurred as a consequence of the industrial revolution was immense – Figure 1 illustrates the relative development in comparison to the base year of 1800.

This historical growth provided the basis for the emergence of today's dominant growth paradigm and corresponding path dependencies. It was crucially based on the use of fossil and natural resources. The development of income was and is closely correlated with climate gas emissions but also with pressure on various ecosystems. The use of fossil resources has in addition led to other diverse impacts, including profound changes in land use which has had immensely negative consequences for biodiversity. There is a close correlation between the transgression of planetary boundaries and observable economic growth.

Traditionally, gross domestic product (GDP) has been viewed as the key 'well-being indicator' and thus became extremely important for economic policy. But as currently defined, it is not a comprehensive measure of welfare or even economic well-being. It was developed in the context of the economic depression at the end of the 1920s in the USA, largely by Simon Kuznets. As a measure of the value of goods and services produced annually, it was not conceived as a comprehensive indicator of well-being. Nonetheless, even today it continues to exercise immense influence on the actions of national, international and supranational organisations and is deeply embedded in decision-making structures. Criticism of the use of this indicator came to a head in the economic crisis of 2008. A particular milestone was marked by the Stiglitz-Sen-Fitoussi commission (2010), which was convened by the French president Sarkozy to discuss different indicators of economic performance and social progress. This

triggered diverse follow-up processes on national and international levels but could do little to limit the pre-eminence of the GDP indicator.

The global challenge of socio-ecological transformation

With the 1.5°C or 2°C objective a central international climate policy goal was stipulated in the Paris agreement. If this goal is taken seriously, then substantial adaptations are required within a period of just a few decades. To date, environmental policy and sustainability policy have not achieved anything close to a sufficiently strong reduction in emissions or ecological damage. Similarly, the world is far from fulfilling the Sustainable Development Goals (SDGs) that lay down 17 objectives for sustainable development in the economic, social and ecological spheres.

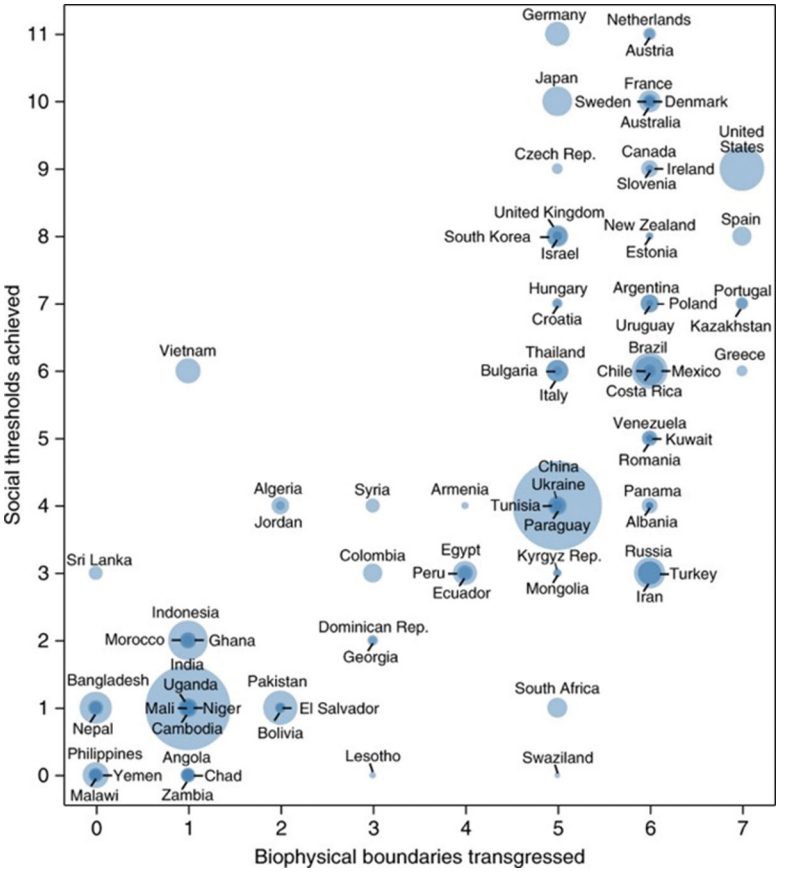
Figure 2, cited from O'Neill, Fanning und Lamb et al. (2018), clarifies the global challenge of the necessary transformation, which, on the one hand, requires a massive reduction in resource use and, on the other hand, an increase in well-being (here termed 'social threshold achieved'), particularly in the Global South.

In Figure 2 the y-axis represents the social thresholds that countries reach. The x-axis shows the biophysical boundaries and the transgressing thereof. Early industrialised countries like Germany are shown to have reached a higher standard in terms of the social dimension but clearly transgress the biophysical boundaries. In contrast, other countries, e. g. Sri Lanka, remain largely within the biophysical boundaries but there is considerable room for development in terms of the social dimension.[4]

Central to the line of argument in this article is that ultimately the aim is to adhere to (biophysical) planetary boundaries and, at the same time, to stabilise the social dimension (social well-being) on a high level, or to further develop it to that level. It therefore comes down to 'filling' the empty quadrant on the top left. It is necessary to develop appropriate development paths based on the different starting positions. In the early industrialised countries, there is a dual goal of reducing resource utilisation and maintaining/further developing quality of life (especially for socially disadvantaged citizens).

4 In addition, it should be noted that the early industrialised countries can also differ considerably in relation to both biophysical and social boundaries.

Figure 2: Fields of tension: biophysical boundaries and social thresholds



Source: O'Neill/Fanning/Lamb et al. (2018)[5]

5 The methodological considerations on which this figure is based are very complex and are therefore not discussed in detail here. Various relevant concepts are combined. Here it should simply be noted that the x-axis comprises the biophysical boundaries transgressed and combines the concepts 'planetary boundaries' (nine boundaries related to critical biophysical processes) and 'ecological footprints' for different types of biophysical resource flows (e. g. CO_2). The resource flows are allocated to the consumers (and thus also include the effects of trade and the imports of products). The y-axis comprises social boundaries/thresholds, drawing on the work of Raworth. Based on Max Neef's human needs approach, Raworth developed a 'safe and just space' (SJS) framework (doughnut approach), which combines the concept of planetary boundaries with the complementary concept of social

In Germany as elsewhere, there is far-reaching consensus in the scientific and political spheres that ecological limits must be adhered to in the long term. How this basically consensual goal is to be achieved is, however, the subject of controversial discussion in both fields.

Two levels can be discerned here. First, there is no agreement about what contribution an individual nation state can and should make to tackling global ecological challenges (see Enquête-Kommission 2013: 477–521). Second, there is key dissent about whether and how the economic system of an early industrialised prosperous country should be changed so as to sufficiently contribute towards an adherence to planetary boundaries without endangering standards of social justice. The relevance of economic development or economic growth for achieving the goals of environmental policy is an especially contentious issue. This is the focus of the rest of this article. We aim to improve understanding of this controversy and derive policy options. To this end, in the next section we develop a systemisation of positions within this social discourse.

Positions in the growth debate

The terms employed in the growth debate – 'green growth' (OECD 2011), 'green economy' (UNEP 2011), 'a-growth' (van den Bergh 2011), 'post-growth' (Zahrnt/Seidl 2010) and 'degrowth' (Demaria/Schneider/Sekulova et al. 2013) – are not always utilised in a distinct and clear-cut fashion. At the same time, it should be noted that in some cases the motivations and discourse contexts behind these terms differ greatly. The discourse surrounding degrowth is fed, inter alia, by feminist positions (a lack of recognition for informal work), anti-capitalist positions (exploitation and self-exploitation), cosmopolitan positions (global inequalities) and of course ecological positions (adherence to planetary boundaries) (see Steffen/Richardson/Rockstrom et al. 2015). The post-growth approach aims to reduce dependence on economic growth in order to overcome ecological challenges and social injustices. For the position 'a-growth', supported particularly by economists, the focus is rather on

boundaries. SJS includes 11 social objectives (selected from the documents of 'Rio plus 20' (2012) and the SDGs), which also take into consideration stocks of critical human and social capital (the basic needs requirement).

achieving aims related to quality of life and adhering to planetary boundaries, while the question of growth is of secondary importance as long as the ecological and social goals can be realised (abandoning the one-dimensional indicator GDP). The green-growth position (which does not use one-dimensional GDP as a key performance indicator) assumes that there is no contradiction between growth and respecting planetary boundaries, GDP should rather continue to grow so that environmental objectives can be achieved.

Degrowth versus green growth

Two particularly prominent and clearly antagonistic positions exist within the growth discourse, and their policy consequences clearly contradict one another: degrowth and green growth.

Within the degrowth discourse models, there is much discussion of political measures and instruments that go hand in hand with (or are meant to lead to) a reduction in economic performance. Representatives of the green growth approach instead focus on economic policy measures intended to make it possible to combine further economic growth with enhanced environmental protection. In order to understand where these two positions contradict each other, we have reconstructed their respective (deductively valid) arguments with the help of philosophical argumentation theory. This analysis shows that the degrowth and green growth positions contradict each other in two theses: a descriptive and a normative one. First, they hold differing views on how economic performance would develop in an early industrialised economy (such as Germany) if the country made a sufficiently strong contribution to meeting global environmental goals. Second, they contradict each other in their assessments of the relevance of further economic growth for maintaining quality of life in a society.[6]

6 Degrowth and green growth proponents very rarely make explicit which conception of quality of life they hold, i. e. which conception of quality of life should be accepted from their respective perspectives. Mostly, similar abstract terms are used: 'welfare' and 'well-being' (especially in green growth), 'happiness', 'good life' (especially in degrowth). The conceptions of quality of life widely used in philosophical and economic literature are discussed in Petschow et al. 2018, 2020a and 2020b.

Representatives of the degrowth position are committed to the following two propositions (e. g. Kallis 2011, Paech 2012, Demaria et al. 2013 or Latouche 2015a/b):

1. Further economic growth in wealthy countries is not necessary in order for them to maintain their quality of life, which can be preserved or even increased even if aggregate economic output falls.
2. It is reasonably certain that economic output in wealthy countries will decline if they reduce their levels of ecological damage sufficiently.

In contrast, representatives of the green growth movement hold contrary positions (e. g. OECD 2011, World Bank 2012, Jacobs 2013 or Bowen et al. 2014):

1. Further economic growth is still necessary in an early industrialised, prosperous economy in order to maintain or improve quality of life in these societies.
2. It is reasonably certain that with the help of green growth instruments, prosperous countries can sufficiently reduce the ecological damage they cause. Their economic output – albeit in a qualitatively different form – could continue to grow.

We then examined the extent to which these core theses of the two basic positions can be scientifically justified. There are fundamental objections to the degrowth propositions. According to our understandings of quality of life based on the philosophical literature (hedonism, desire fulfilment theory, theories of objective values), the first degrowth thesis does indeed apply. Further economic growth is, in principle, not necessary to maintain the quality of life in a society. However, degrowth representatives do not convincingly explain whether and in particular how this quality of life can be maintained if GDP per capita (very) sharply declines.

The second degrowth proposition claims that it is impossible to sufficiently decouple economic growth from environmental impacts. This is scientifically untenable. Representatives of the degrowth position usually point out how extensive the ecological challenges are, how short the period for reducing ecological burdens is, and how little previous environmental policy efforts have achieved. They also emphasise that a positive correlation

between economic growth and the consumption of natural resources and greenhouse gas emissions has been observable since the nineteenth century. The parameters relevant to the success of decoupling – the decarbonisation rates of an economy, development of energy and resource intensities – however, can be influenced politically (e. g. by taxes, incentives, technology promotion, etc.). Thus, forward projections of trends based on a past in which there was no or insufficient political control cannot be used to prove that decoupling cannot or will not succeed in the future.

Whether or not the first proposition of the green growth position is true crucially depends on one's understanding of social quality of life. Some of the views expressed in the philosophical literature on what constitutes a good life or social quality of life do not support the green growth thesis. Conversely, the core thesis of green growth can be justified particularly well if one uses the concept of quality of life supported by welfare economics: quality of life ('welfare' in the language of economics) is then an aggregate of the extent to which individual preferences are met. However, it is not clear why *this* particular understanding of quality of life, as the fulfilment of individual preferences, should guide political action.

Turning to the second green growth proposition, economic-ecological models demonstrate that it is theoretically possible to decouple future economic growth from critical resource consumption and ecological damage. However, model results to date do not demonstrate that this will succeed to a sufficient extent within the available time frame. In addition, the models assume that the technologies required for decoupling will be invented and adopted in good time. It seems hardly possible to make scientifically serious statements on this – at least, such statements must be fraught with great uncertainty; in addition, rebound effects must be considered. Last but not least, there is no robust knowledge about the consequences for future economic performance of reducing all the ecological impacts relevant for compliance with planetary boundaries simultaneously, as opposed to pursuing just one ecological goal, such as the reduction of GHG emissions.

The precautionary post-growth position: a new consensus?

The above discussion demonstrates that degrowth and green growth positions are based on core assumptions that cannot be adequately justified or substantiated scientifically. Neither position can thus claim to serve as the sole strategy for environmental policy action. Based on this criticism, we have developed a third, ideal-typical approach, which we refer to here as the post-growth position. In contrast to degrowth and green growth, post-growth is open and unbiased. It has no strong ex-ante premises regarding either (i) an evaluation of future economic growth or possible future contraction, or (ii) the possibility of sufficient decoupling. According to this position, it is uncertain as to how economic performance will develop if the economies of prosperous countries are fundamentally changed in line with global environmental objectives. There is, however, a serious possibility that economic output will no longer increase or even significantly decrease as a result of this transformation. At the same time, we note that economic performance and the income it generates play an important role because of the current state of the early industrialised, prosperous countries. They are crucial to the functions of fundamental social institutions that provide the components of a good life (e. g. social security systems, expenditure on education, etc.). From this position, we can derive the goal of transforming these social institutions as a precautionary measure, thus ensuring that they can continue to perform their functions independently of economic output. Greater independence from growth would make it possible to maintain a high level of social quality of life even if economic output stagnates or falls. In a society that is more independent of growth in this sense, there would be fewer conflicting goals between economic and environmental targets. Environmental policy measures would thus be less subject to reservations about possible growth impacts.

We chose the term *post-growth* for this ideal-typical position, developed as a third choice between degrowth and green growth. The key political implication of this position – the creation of social institutions that are (more) independent of growth where possible – was, to our knowledge, first emphasised in the volume *Postwachstumsgesellschaft – Konzepte für die Zukunft* (Post-growth society – Concepts for the future) by Angelika Zahrnt and Irmi Seidl (2010). In addition, there are overlaps in content with the position of authors who advocate the concept of 'a-growth' (e. g. van den Bergh

2011) or are close to it content-wise (Jakob and Edenhofer 2014). Moreover, in parallel to the study on which this paper is based, other scientific papers have been presented that have reached similar conclusions, such as van den Bergh (2017) and Scientific Working Group (2018).

We aim to build on these contributions with our precautionary post-growth position. In doing so, we would like to add that the involvement of the public and key stakeholders in deliberative processes is central to a post-growth position. When it comes to developing strategies and instruments, it is in fact dependent on them. Only a deliberative discourse with broad public participation can clarify the level or amount of services that a specific area of society or a specific public institution should provide. In our view, a close iterative exchange between politics, science and the interested public can support such a discourse.

Precautionary post-growth position and societal change

In the growth debate, the green-growth and degrowth positions adopt different perspectives based on central normative considerations and evaluations, some shared, some not.

The commitment to respect planetary boundaries is considered essential by representatives of the positions 'green growth', 'degrowth' and 'post-growth', as well as by the team of authors of the study undertaken on behalf of the Environmental Protection Agency (Petschow/aus dem Moore/Pissarskoi et al. 2018) on which this paper is based.

For example, to be successful green-growth approaches require a decoupling of economic growth and environmental pollution through technological innovations and this to an extent that has not yet been attempted. It also remains unclear whether the necessary decoupling could be achieved quickly enough. Furthermore, the notion that a forceful and far-reaching green-growth strategy (which has not yet been consistently introduced) will not have negative impacts on economic growth in the short and medium term can be disputed.

Regarding the degrowth approach, on the other hand, it is uncertain whether the quality of life in society can be maintained by implementing degrowth measures, and the question of which interpretation of quality of life should be sustained remains normatively controversial.

The societal discourse on environmental policy is characterised by a high degree of segmentation and polarisation, documented most visibly in the dispute on the issue of growth. In this debate, green growth and degrowth mark the opposite ends of a broad and varied spectrum of individual positions. This situation impedes the productive use and combination of important insights from both strands of the debate. Against the backdrop of the antagonistic positions of green growth and degrowth and the need to develop a consistent sustainability policy, it seems highly desirable to explore the potential for mutual understanding in the sustainability debate by trying to identify consensual elements that can be productively applied in policy.

In concrete terms, it should also be noted that the above-mentioned positions still have limited significance for the policy and society. Solution approaches are available but have not been sufficiently taken up. The proponents of a green-growth approach undoubtedly propose suitable instruments from a theoretical perspective, but nevertheless political 'demand' for these instruments and their effective implementation in practice have so far been very limited. Similarly, the ideas and models developed within the ecologically oriented post-growth discourse have so far also had only limited appeal and acceptance.

In view of path dependencies and doubt regarding the directional reliability of the strategies pursued, the precautionary post-growth position aims to initiate a design-oriented search process that focuses on key notions such as the precautionary principle and societal resilience. This participatory, long-term process of societal change can only be controlled to a limited extent. It is intended to open up new options for action and development and must take account of initial social conditions. Compliance with planetary boundaries requires far-reaching societal change. Against the background of our limited knowledge, there is no single concrete transition path or approach that should be pursued in isolation. In our view, instead, action-oriented strategies and corresponding 'policy mixes' must be developed that include combinations of efficiency, consistency and sufficiency.[7] On the one hand, these should draw on appropriate and mutually compatible elements of different strategy approaches and, on the other hand, should connect to 'the here and now'. It will be crucial to promote bottom-up initia-

7 On the debate about efficiency, consistency and sufficiency, see for example Huber (1994), current discussion in Schneidewind and Zahrnt (2013) and Loske (2015)

tives and experiments. These can be supported in particular by national and/or international frameworks. For approaches that have been evaluated and assessed by ongoing critical research and thus can provide 'proof' that they achieve what is desirable and intended, the next step is to examine their scalability and whether they can be adopted as top-down policies. Relevant contexts for testing such approaches exist, for example, both in regions undergoing structural change and in the more general challenges of decarbonising energy supplies or promoting the circular economy.

The competing concepts of 'green growth', 'a-growth', 'post-growth' and 'degrowth' differ in their fundamental orientations, in some facets considerably, and are to some extent incompatible with regard to central premises. However, in terms of the recommended instruments, reform approaches and concrete paths for transformation, it is certainly possible to identify considerable overlaps. The precautionary post-growth position draws on these overlaps and is composed of four action strategies which are outlined below (see Petschow/aus dem Moore/Pissarskoi et al. 2018, aus dem Moore and Hofmann 2019, Petschow/aus dem Moore/Pissarskoi et al. 2020a, 2020b).

From the culture of growth to the culture of sustainability

The *first* action strategy promotes cultural change from a 'Culture of Growth' to a 'Culture of Sustainability'. Direct management of this cultural process is only possible to a very limited extent. Nonetheless, it can be seen that social discourses echo the sustainability debate and, currently even more so, the climate and biodiversity discourse. The post-growth/degrowth movement, which is shaped by civil society, is itself an expression of incipient cultural change.

On the question of which factors significantly influence profound processes of social change, there are very different answers in the relevant academic discourses. In discourses on economic history and institutional economics, the thesis is increasingly being advanced that cultural changes can be regarded as the trigger for growth dynamics and the emergence of the growth society. As discussed above, economic growth only became relevant with the start of the industrial revolution and finally began to guide action and policy with the development of the growth indicator GDP.

The hitherto dominant culture of growth is deeply embedded in the formal and informal institutions that 'steer' our societies. If policy approaches are to lead to us living within planetary boundaries, they must therefore go beyond material goals and the instruments directly geared to such goals and must also consider cultural change towards a possible culture of sustainability. A robust process of change towards a sustainable society that enables societal well-being within planetary boundaries will not be possible without a profound transformation (also) of formal and informal institutions (see Williamson 2000, Geels 2011)[8].

Effective design of economic frameworks

The *second* building block of the precautionary post-growth position is adjustment of the economic parameters, in particular through the resolute use of (market-based) instruments to internalise negative environmental externalities and thus ensure effective and systemic coarse-grained management. These instruments include cap-and-trade systems (in emissions trading, for example) or eco-taxes for the cost-effective internalisation of the environmentally harmful effects of production and consumption.

In this respect, there is widespread agreement between the positions in the growth debate. Moreover, most actors putting forward economic arguments consider relative prices to be significant for individual behaviour and the overexploitation of natural resources (such as energy carriers or sinks or the absorption capacity of the atmosphere). Thus, across the board, i. e. among both degrowth and green-growth advocates, changing relative prices is considered an important regulatory element.[9]

Remaining within planetary boundaries, the far-reaching need for change and the necessary economic instruments with which to address this change are all clearly associated with considerable potential for social con-

8 The multi-level perspective (Geels 2011) is currently a widely used heuristic for complex social change processes.

9 It should be noted that, especially in the degrowth and post-growth discourse, this is rarely made explicit but is rather applied more generally, leading to the development of behavioural orientations which can often have an 'overwhelming' effect on individuals.

flict (for instance with issues of distribution). This must be flanked by additional measures.

Exploration and potential development of new paths of societal development

The *third* approach of the precautionary post-growth position involves exploring and opening up new paths of social development and is complementary to the previously discussed degrowth and green growth approaches. The exploration of more sustainable options for action must be stimulated, accompanied and supported by participatory societal search processes, experimental spaces for new social practices, new innovation policies and research policy approaches.

Inevitably, this means that growth of GDP should no longer be seen as the dominant target of society. Instead, the focus should be increasingly on socially desirable target states (societal well-being, good life, etc.). The social shift towards a culture of sustainability also requires other systems of indicators to guide societal (self-)management.

Innovations will play an important role in these search processes, but relying solely on technological innovations is by no means sufficient (see also Deutscher Bundestag 2013: 477). In the context of defining the 'Grand Challenges' on EU level, prominent calls for more social innovations were heard, i. e. for innovations that focus less on technology and more on new social practices. Since then, the concept of social innovations has been increasingly important in the field of innovation promotion.

These new ways of generating innovations are now also found in the mainstream, with the establishment of real-world laboratories and experimental spaces becoming increasingly ubiquitous ways of generating solutions. At the EU level and also at the national level, consideration is being given to how real labs or experimental spaces can be designed to engender new, sustainable solutions – for example, through the promotion of real-world laboratories in Baden-Württemberg or with a more technical focus like in the German government's energy research programme (BMWi 2018).

Calls for these social innovations come particularly from representatives of the post-growth discourse. The aim is to identify new generalisable solutions that should then be supported by regulation or infrastructural develop-

ment. Against this background, there is a need to strengthen transformative elements in innovation policy to address socio-technical regimes as a whole, in line with the goals of society. Such an innovation policy would encourage social experimentation and social learning processes so that previously unknown paths to sustainable development become possible.

This is also necessary given the characteristics and path dependencies of the dominant socio-technical 'system', such as current high energy and resource consumption. Representatives of the multi-level perspective believe that economic instruments alone are hardly sufficient to overcome these path dependencies (Kern/Rogge/Howlett 2019). The 'deep transition' approach (Schot/Karger 2018) is linked to this multi-level perspective. Both emphasise the importance of social innovations and do not consider the prevalent focus on technological innovations as sufficient to drive social change processes.

Reduction of growth dependency

Another and therefore *fourth* important path dependency concerns the dependence of important spheres of society and institutions on growth. Consequently, we see a fourth element as constitutive for our proposed precautionary post-growth position: identifying and developing the potential for designing more growth-independent societal institutions and processes. This is, we believe, also essential to increase the resilience of important social systems. Appropriate measures should be implemented if they are shown to be effective and socially acceptable. To this end, appropriate pilot projects should be designed, implemented and evaluated.

If a strategy of increasing growth independence is successful, social acceptance of environmentally motivated policy measures may well increase, despite their potentially negative impact on economic growth. Such policies would suffer less from 'growth proviso' and there would be more scope for an ambitious environmental and sustainability policy.

Existing approaches intended to achieve greater independence from growth are currently proving to be only marginally effective (Petschow/aus dem Moore/Pissarskoi et al. 2018, Petschow/aus dem Moore/Pissarskoi et al. 2020a, 2020b). Fundamental reform approaches, if any, have to date only been considered for small sections of society and pursued in a series of small experiments. It is therefore hardly possible to draw any conclusions

about the generalisability of such approaches or their potential to reduce the existing dependence on growth. However, the prospects of success of the dominant approach so far, the green growth strategy, are uncertain in terms of the chances of decoupling economic growth from negative environmental impacts. It thus seems necessary to continue working on the conception and testing of models that are less dependent on economic growth. We see a considerable need for research in this area.

Conclusion: The precautionary post-growth position as a platform for further discourse

The precautionary post-growth position represents, first, an integrative approach and, second, provides general impetus for further discussion on transformation paths, especially with regard to the economic discourse. The concept of 'growth independence' aims to change prevailing social models and path dependencies and, in this sense, has the potential to bring about far-reaching processes of change.

However, the goal of 'societal well-being within planetary boundaries' must ultimately be specified in processes of societal negotiation, and effective narratives must be developed in a participatory manner. We interpret the precautionary post-growth position, both conceptually and practically, as a relevant and important building block of a yet-to-be-conceived, consistent and global strategy for adhering to planetary boundaries and the SDGs, and for promoting individual quality of life and societal well-being.

From a policy perspective, a post-growth position understood in this way can also be seen as a starting point or essential component of an overarching resilience strategy motivated by responsible ethics. Given the uncertainty about future economic and societal developments, this would enhance the robustness of the transformation process towards a sustainable society within planetary boundaries.

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