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HAMBURG CLIMATE FUTURES OUTLOOK

Assessing the plausibility of deep decarbonization by 2050

Synergies and trade-offs in the assessment of plausible climate futures (1/2)

There is robust evidence that ambitious climate change mitigation can be in conflict with some sustainable development goals (SDGs), resulting in trade-offs, while showing potential for synergies with others (Pradhan et al., 2017; Fuso Nerini et al., 2019; Kroll et al., 2019). Scenarios that both limit global warming and exploit synergies across multiple SDGs are explored in the *IPCC Special Report on Global Warming of 1.5°C* (SR1.5) in the form of *climate-resilient development pathways* (Roy et al., 2018). The SR1.5 claims that scenarios which both limit global warming and enhance sustainability and equality (e.g., SSP1 or SR1.5 P1) in fact "show fewer mitigation and adaptation challenges and are associated with lower mitigation costs" (IPCC, 2018b). The synergies in low emissions scenarios can even outweigh the costs of mitigation. Examples of such synergies are improved air quality and human well-being. Trade-offs, however, exist between mitigation strategies and strategies for enhancing biodiversity and food security, such as in the case of large-scale employment of land-based carbon dioxide removal technologies (Rogelj et al., 2018; Karlsson et al., 2020).

With respect to the plausibility of climate futures, we argue that a scenario such as deep decarbonization becomes more plausible if we observe increasing evidence for synergies between ambitious climate action (SDG 13) and other goals, and less plausible if we observe increasing evidence for trade-offs. While the SR1.5 stresses the potential for synergies (Roy et al., 2018), recent attempts to assess the trajectory of synergies and trade-offs between SDGs (Pradhan et al., 2017), specifically between SDG 13 and other SDGs, suggest "notable trade-offs" (Kroll et al., 2019) could emerge in the future. Nevertheless, the actual manifestation of synergies and trade-offs between SDGs is highly context-specific, as are climate-resilient development pathways. Therefore, we need an approach that allows a qualitative perspective on social-ecological conditions and contexts. The following example of urban development illustrates potential trade-offs and synergies between climate change mitigation, adaptation, and human development.

Example: Trade-offs and synergies in climate-friendly urban development

Urban development is currently facing considerable challenges, including the need to transform cities toward increased mitigation and resilience (Rosenzweig et al., 2018; Chatterton, 2020). Trade-offs and conflicting goals are becoming apparent on multiple levels. A well-known example is the spatial trend toward de-concentration and suburbanization (e.g., of residents and workplaces) and the concurrent intentions to promote a compact city based on concentration and densification (SDG 11). From the perspective of climate change adaptation, decentralized settlement structures are more resilient. Not only do they provide more green and blue spaces to counter microclimatic problems or buffer against extreme events, they also increase the capacity for self-sufficiency. The spatial distancing of decentralized structures also makes it easier to respond to crises (such

Synergies and trade-offs in the assessment of plausible climate futures (2/2)

as COVID-19). However, urban sprawl has been criticized for decades as it goes hand in hand with increased land use, long travel distances, higher costs for supply infrastructure, and therefore with higher greenhouse gas emissions. Denser structures, on the other hand, have advantages with respect to more efficient material and energy flows, short distances and easy accessibility, making them preferable from the perspective of climate change mitigation. At the same time, this requires external food, energy and water supply, and creates dependencies between cities and their hinterlands.

Contradictions between controversial adaptation and mitigation goals are becoming apparent. New ways of dealing with water in the city, for example, where the concept of the *sponge city* is replacing the former idea of *drying the city*, are subject to increasing competition for space (Bell et al., 2017). Adaptation interventions in favor of a sponge city will lead to additional cooling effects, and an increase in green spaces and biodiversity as rainwater and floods no longer run off quickly but are absorbed in the city. The space this requires, however, and the associated re-design of infrastructure is likely to require high investment costs. More incentives for sustainable urban lifestyles linked to walkability, bikeability, consistent reduction of waste and recycling, use of recycled water, co-managed sustainable energy supply, and local producer-consumer associations are central to the New Urban Agenda (UN, 2017). At the same time, urban real-estate price increases that result from ecological restructuring could promote the displacement of socially disadvantaged groups, and *green gentrification* has already become a new catchphrase describing ecologically oriented, but socially imbalanced urban development (Gould and Lewis, 2017).