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Urgent need for post-growth climate mitigation scenarios

Established climate mitigation scenarios assume continued economic growth in all countries, and reconcile this with the Paris targets by betting on speculative technological change. Post-growth approaches may make it easier to achieve rapid mitigation while improving social outcomes, and should be explored by climate modellers.

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As the world faces the reality of climate breakdown, citizens, social movements and governments are grappling with how to respond. But so far the public debate has been constrained mostly to the policy options that are represented in existing climate mitigation scenarios.

Existing scenarios start with the assumption that all nations should continue to pursue economic growth for the rest of the century, regardless of how rich they have already become. Growth is an unquestioned norm[1]. This creates a problem because growth is projected to drive a significant increase in energy demand over the coming decades, making it more challenging to decarbonize the economy[2]. To reconcile growth with the Paris Agreement goals of keeping global warming below 1.5 °C or 2 °C, existing scenarios gamble on dramatic technological change, particularly negative emissions technologies and productivity improvements big enough to drive absolute decoupling of gross domestic product (GDP) from energy use.

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In recent years, however, scientists have raised substantial empirical questions about the risks of negative emissions technologies and the feasibility of achieving sufficient absolute decoupling, warning that these approaches may not be adequate to address the crisis we face[3].

Recognizing these challenges, ecological economists have proposed an alternative approach. For high-income countries, continued economic growth may not be necessary. Instead, they can adopt post-growth policies, which are designed to keep economies stable and support strong social outcomes without economic growth[4].

Policymakers commonly regard economic growth as a proxy for human development and social progress. But past a certain point, which high-income nations have long exceeded, the correlation between GDP and social indicators breaks down or becomes negligible. For instance, Spain significantly outperforms the USA in key social indicators (including a life expectancy that is five years longer), despite having 55% less GDP per capita. When it comes to achieving strong social outcomes, what matters is not a continuous increase in commodity production, but access to livelihoods and provisioning. In high-income countries, delivering the latter does not require additional growth; rather, it requires a fairer distribution of income and wealth, and guaranteed access to universal public services. Post-growth scholarship demonstrates that by organizing the economy around principles of equity and sufficiency, societies can deliver high levels of human well-being with significantly less energy and resources than rich countries presently use[5,6].

Post-growth policies are powerful because they would make it possible to achieve the Paris climate goals without having to rely so heavily on negative emissions technologies or productivity improvements[7]. So far this approach has not been modelled in mainstream climate mitigation scenarios, however. To honour the precautionary principle, and in order to facilitate a public discussion about alternative pathways, the range of scenarios should be expanded to include post-growth futures.

Risky assumptions

To achieve emissions reductions consistent with the Paris Agreement, while respecting the principles of equity and common but differentiated responsibility, high-income nations need to pursue dramatic emissions reductions[8]. If we assume that high-income nations continue to grow at usual rates, they will need to decarbonize their economic output by more than 12% per year. This represents a significant challenge, given that the few countries that have absolutely decoupled GDP from emissions (such as the UK, Spain and Romania) have on average achieved decarbonization rates of only 3.4% per year from 2005 to 2015[9].

To reconcile growth with the Paris Agreement goals, the majority of scenarios reviewed by the Intergovernmental Panel on Climate Change (IPCC) rely heavily on the assumption that negative emissions technologies — mostly bioenergy with carbon capture and storage (BECCS) — will be scaled up later this century to remove excess carbon from the atmosphere. This assumption has come under significant criticism in recent years, however. Scaling BECCS would require massive amounts of agricultural land and water for biofuels, which raises questions about land and water availability, competition with food production, emissions from land-use change, water depletion and biodiversity loss[10]. Alternative carbon removal strategies such as direct air carbon capture and storage (DACCS) may avoid some of these problems, but could use up to 50% of the world's current electricity generation to achieve the carbon removal rates assumed in existing scenarios, making it more difficult to decarbonize global energy supply[11]. In both cases, there are questions about the availability of sufficient storage capacity for captured carbon[12].

In light of these uncertainties, scientists increasingly regard reliance on negative emissions technologies to be speculative and risky[8,13–15]. If this approach fails, we will be locked into a high-temperature trajectory from which it would be impossible to escape. It is also worth noting that even if BECCS or DACCS were to succeed at scale, this might address emissions but it would do nothing to address overshoot of other planetary boundaries, such as land-use change, biodiversity loss and biogeochemical flows, all of which are being exacerbated by rising resource use. Relying on negative emissions technologies is not an ecologically coherent approach to the crisis we face.

If we dial down our assumptions about negative emissions, the only way to achieve the Paris climate goals is to significantly reduce energy demand, making it easier to accomplish rapid decarbonization. This approach is represented in a number of existing scenarios, and is exemplified by the low energy demand (LED) scenario that was highlighted in the IPCC's Special Report on 1.5 °C (ref. [16]). In this scenario, global final energy demand declines from 400 EJ yr^{-1} to 245 EJ yr^{-1} in 2050, with these reductions accomplished in large part by declining resource use, particularly in the Global North.

The principle of reducing energy and resource use represents a safer and more ecologically coherent approach to climate mitigation. But because the LED and other low-demand scenarios developed with Integrated Assessment Models presuppose continued GDP growth, they can only achieve these reductions by assuming a dramatic absolute decoupling of global GDP from energy and resources. In the LED scenario, for example, improvements in annual energy intensity (energy consumption per unit of GDP) increase from 1.5% per year (the average from 2010 to 2020) to a staggering 5.2% per year during the next decade. Similar assumptions feature in other high-decoupling scenarios reviewed by the IPCC[17].

Several studies have raised questions about the feasibility of achieving absolute decoupling on the scale required by these scenarios. Empirical evidence demonstrates a strong relationship between GDP and energy use[18]. Relative decoupling has been occurring for most countries, particularly high-income countries, but we must be mindful of the extent to which the latter is an effect of the geographical disjuncture between where production takes place and where GDP is captured. At regional and global levels, there is no evidence of absolute decoupling[18], and modelled projections indicate that with existing growth trajectories, absolute reductions in energy use are unlikely to be achieved[19].

One possible reason for this is that in a growth-oriented system, productivity improvements are leveraged to expand production and consumption[20], often leading to large rebound effects that are not accounted for in existing scenarios[17,21]. These conclusions hold despite a significant shift to services and digitalization over the past decades. In fact, tertiarization in industrialized countries[22], as well as the efficiency improvements achieved through digitalization[23], have led to increases in energy use and CO_2 emissions.

The same is true when it comes to resource use. The empirical record demonstrates a strong relationship between GDP and material footprint[18], and modelled scenarios show that under growth-as-usual conditions absolute reductions in resource use are unlikely to be achieved at a global level even with dramatic efficiency improvements, in large part because of rebound effects[3].

The post-growth alternative

Given these uncertainties, it is possible that existing approaches may fail to deliver the mitigation that is required to achieve the Paris climate targets. It makes sense therefore to consider alternative post-growth scenarios that would reduce the pressure to rely so heavily on negative emissions and absolute decoupling. Towards this end, we can build on the core insights of the low-demand scenarios, accepting that significant reductions of energy and resource use are necessary in order to make rapid decarbonization feasible, while pursuing sufficiency-oriented policies in addition to efficiency improvements to get there.

Post-growth scholarship calls for high-income nations to shift away from pursuing GDP growth and to focus instead on provisioning for human needs and well-being, such as by reducing inequality, ensuring living wages, shortening the working week to maintain full employment, and guaranteeing universal access to public healthcare, education, transportation, energy, water and affordable housing. This approach enables strong social outcomes to be achieved without growth, and creates space for countries to scale down ecologically destructive and socially less necessary forms of production and consumption, as proposed by degrowth research[24].

In high-income nations, possible policy interventions might include the following.

In the transportation sector: shifting from private cars to public and non-motorized transportation; and reducing air travel in a fair and just way, for example by removing subsidies for aviation, equalizing or increasing taxes on aviation fuels compared with those of land transport, and introducing frequent flyer levies or a rationing framework.

In the industrial sector: extending product lifespans through warranty mandates, rights to repair, and regulations against planned obsolescence; incentivizing and institutionalizing second-hand product purchases over new; regionalizing production and consumption where possible to reduce freight; limiting advertizing; and shifting taxes from labour to resources.

In the agricultural sector: minimizing food waste; reducing industrial production of ruminant meat and dairy, while shifting to healthier plant-based diets; and prioritizing agroecological methods to sequester carbon and restore biodiversity.

In the buildings sector: promoting maintenance and retrofits over new construction; improving efficiency and reducing energy use of existing buildings;

reducing the average size of new dwellings; introducing progressive property taxes; and mandating net zero energy certifications.

In cities: urban planning to enable 15-minute urban centres requiring little motorized travel and sufficiently compact to encourage reasonable-sized dwellings; and reallocation of some public urban space from parking structures and roads to infrastructure for non-motorized mobility.

Interventions such as these would make it possible to achieve rapid decarbonization consistent with the Paris Agreement goals, without relying so heavily on negative emissions technologies and productivity improvements[25]. A recent study modelling some of these interventions, with equitable access to the energy services required for decent living, brings global final energy demand to as low as 150 EJ, well below the LED and other IPCC scenarios[6].

Finally, it is important to take global justice considerations into account. Existing climate scenarios maintain a significant disparity in per capita energy use between the Global North and Global South[26,27]. There is some relative convergence in certain scenarios, but none assume an absolute convergence. This approach is morally problematic, politically untenable (why should Global South negotiators accept such scenarios?), and potentially inconsistent with human development objectives. Instead, we should explore convergence scenarios, reducing excess throughput in the Global North and increasing necessary throughput in the Global South so that energy and resource use converge at per capita levels that are consistent with universal human welfare and ecological stability.

Post-growth mitigation scenarios

All climate mitigation scenarios envision plausible but not-yet-realized future transformations. We hold that socially and politically ambitious post-growth scenarios merit equal consideration to technologically ambitious scenarios, and should be included alongside them[28]. Given the enormous challenge of confronting the climate crisis, and following the precautionary principle, modellers should consider a wider range of policy options in order to expand the public debate about climate mitigation, and to reflect the plurality of visions for a sustainable world.

This requires diversifying the frameworks used in modelling experiments. The narratives of the Shared Socioeconomic Pathways (SSPs) assume that even moderately slower rates of economic growth (such as in SSP3 and SSP4) are associated with deepening inequalities, regional rivalries and less technological innovation, therefore increasing the challenges of mitigation[29]. But the literature in post-growth economics shows that it doesn't have to be this way; high-income nations can maintain economic stability, invest in innovation and achieve strong social outcomes without the need for additional growth, thereby making mitigation easier to achieve[7,30,31].

The SSPs and Integrated Assessment Models should be updated, or new ones created, to incorporate frameworks developed by research in social metabolism, industrial ecology[32] and ecological economics[7], so that post-growth scenarios can be successfully modelled. Such alternative frameworks would illuminate new possibilities and help broaden the range of policy options for public debate. ❐

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Competing interests

The authors declare no competing interests.