

A truly sustainable future

Debates about the need to avert environmental disasters and to help the most vulnerable are marred by economic and energy security concerns. They shouldn't be, as the only path to success is a green and equitable one.

The much anticipated third instalment of the Sixth Assessment Report of the UN Intergovernmental Panel on Climate Change (IPCC) was finally released on 4 April; not quite on schedule due to tense negotiations between government officials and scientists during the preceding weekend. The top line from the science community was loud and clear in the previous two instalments of the report already published: the world has to substantially cut carbon emissions in order to keep the target of limiting global warming to 1.5 °C within reach, and such reductions need to happen over the next decade or two. The third instalment of the report focused on what needs to be done to cut emissions — the proposed roadmap raised the stakes of many countries, leading to heated discussions. Overall, not news to most of our readers, except perhaps the unequivocal language used.

Once again, developing countries wanted stronger commitments from richer countries, historically responsible for climate change, to support decarbonization efforts in more vulnerable economies that otherwise would have to shoulder a too high cost to develop sustainably. Sustainable development policies must address many interconnected issues, and climate change is one of the most pervasive problems. Indeed, designing sustainable development trajectories requires finding ways to preserve ecosystem services while feeding a growing population, tackling inequalities, and reducing pollution and waste while ensuring mobility, access to modern technologies and healthcare services, to name just a few of the challenges. For many countries, sustainable development means lifting millions of people out of poverty while protecting the natural world and using natural resources prudently. This represents one of the most challenging trade-offs politicians have to grapple with: allowing countries to grow enough wealth to reduce poverty without impacting humanity's life-support system. A great deal of research has looked into this. A study by Hubacek and colleagues in this issue of *Nature Sustainability* estimates the carbon implications of poverty alleviation — although globally poverty-alleviation efforts might not lead to a substantial increase of



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carbon emissions, across poor countries in sub-Saharan Africa those emissions can more than double. If governments are serious about climate change and reducing inequalities, richer nations have to bear most of the cost. Developing countries at the negotiating table of the third instalment of the UN report had a point.

Reducing our reliance on fossil fuels within the current decade or so faces additional hurdles — economies are just restarting after the paralysis due to the COVID-19 pandemic, and despite the stated green aspirations of many governments, things look bleak given the recent events in Ukraine and the resulting national apprehension regarding energy security across most western countries. Yet, ensuring energy security and strengthening economies cannot justify re-expanding the use of fossil-fuel energy — that would be a catastrophic U-turn. The third instalment of the report made it clear that a considerable amount of the fossil-fuel infrastructure will need to be abandoned in favour of adopting renewable technologies, transport electrification, better energy efficiency and the use of alternative fuels such as hydrogen, just some of the solutions put forward for climate change mitigation. We certainly agree. However, scaling up some of the proposed solutions does come with its own challenges. Let's take renewable energy. The cost of renewable-energy technologies has been dropping steadily over the years, and according to many experts decarbonizing the energy system is possible. Solar power is abundant and within reach. But fully decarbonizing

electricity grids will require tens of terawatts of installed photovoltaic capacity over the next decades, meaning a huge scale up of photovoltaic manufacturing with important implications for minerals. An Analysis by Lennon and colleagues in this issue estimates that growing to 60 TW of photovoltaic capacity could require up to 486 Mt of aluminium by 2050. Aluminium mining and primary production are energy-intensive processes, therefore the aluminium demand to scale up photovoltaic capacity carries a substantial global warming potential. The study emphasizes the need to maximize the use of secondary aluminium, that is, recycled aluminium, whose production requires considerably less energy, and to decarbonize the electricity grid within ten years if climate targets are to remain achievable. Many experts suggest that reducing the likely environmental impacts of photovoltaic manufacturing calls for the design of photovoltaic modules with recycling and materials re-use in mind.

Materials recycling and resource efficiency are crucial dimensions of sustainable development and play a key role in the fight against climate change. But it's not all about fossil-fuel energy. We mustn't forget that the materials used to manufacture most things we use, such as utensils, storage containers and packaging, paint, clothing fibres, parts of buildings and vehicles, and many more, derive largely from fossil fuels. Even if we succeed in fully decarbonizing the energy system, we will still be extracting fossil fuels to support our lifestyles. A world free of fossil fuels as feedstock to manufacture things is not in sight yet, and might not be anytime soon, despite growing research efforts towards developing new materials and fuels. This is why a truly sustainable future, one that maintains the well-being of people and nature, rests ultimately on how individuals choose to live their lives — the choices we make today will affect generations to come. Using critical resources frugally, as well as re-using them, and distributing them equitably is the only path for humanity to thrive. □

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