THE URGENCY OF CLIMATE MITIGATION FOR COP27 AND BEYOND

KEY MESSAGES

- **Countries' Nationally Determined Contributions (NDCs)** are not sufficient to meet the Paris Agreement goal of limiting global temperatures to 1.5°C. Updated NDCs, as well as enhanced action to deliver on emissions reduction pledges, is urgently needed from countries.
- **The window of opportunity to achieve 1.5°C** with limited overshoot is closing rapidly, but pathways exist to achieve it. All sectors face requirements for very steep reductions in their emissions, without any time to delay.
- **Societal change to reach net zero is both possible and desirable:** climate action significantly enhances wellbeing, and helps achieve wider environmental, social and economic goals.
- **There has been significant progress** in the development of climate mitigation technologies. Their effective deployment to reduce emissions rapidly requires a set of enabling conditions facilitated by governments.
- **Most of the measures required** to reach net zero emissions will require behaviour change by citizens and businesses, and will need support through economic, regulatory and informational policies that remove cost, convenience and social barriers.
- **Pathways towards low-carbon futures** must be fair, affordable and leave no-one behind. A just transitions approach must apply to both mitigation and adaptation solutions.
- **Climate finance** from high-income countries is essential to support low-and middle-income countries to both mitigate and adapt to climate harms. COP27 will need to see high-income countries honour existing unmet pledges on climate finance and agree further finance post-2025.

As countries gather at COP27 in Sharm El-Sheikh in Egypt, global emissions are still far from falling at the rate necessary to limit warming to 1.5°C, as agreed in the Paris Agreement. Alongside a focus on advancing action to adapt to the harms caused by accelerating climate impacts, and the necessary finance to support vulnerable countries in doing so, COP27 will need to drive action on urgent climate mitigation to create a safer, net-zero world.

The impacts of climate change are already being experienced across the world, with the most vulnerable communities often most severely impacted, and these worsening climate extremes are showing clearer than ever that adaptation alone will not be enough to create a climate-safe world.[1] Limiting global warming to close to 1.5°C through near-term mitigation actions will substantially reduce loss and damage from climate change to human systems and ecosystems, compared to higher warming levels.[2]

Authors:

Dr Neveen Abdelrehim; University of Newcastle; Dr Simone Cenci, Imperial College London; Dr Lucia Corsini, Brunel University London; Dr James Dixon, University of Oxford; Dr Chris Jones, Met Office Hadley Centre; Dr Shefali Khanna, Imperial College London; Dr Camilla Mathison, Met Office Hadley Centre; Katrine Tilgaard Petersen, Imperial College London; Dr Carol Turley, Plymouth Marine Lab; Professor Lorraine Whitmarsh, Centre for Climate Change and Social Transformations.

Strong mitigation actions to limit warming are essential, as the effectiveness of adaptation to reduce climate risk across multiple sectors, ecosystems and nations will decrease with increasing warming. At the same time, adaptation also plays a crucial role in reducing vulnerability and exposure to existing impacts.

As such, **mitigation and adaptation must be integrated and delivered alongside each other.** Both can contribute to sustainable development goals – e.g. low-emission energy has benefits for air quality and health[3], while many land management options promote food security.[4] Mitigation also facilitates more effective adaptation, especially where there is limited capacity to adapt. More vulnerable communities often have a limited ability to adapt to changes in climate, which means effective, sustainable reductions in emissions are likely to have significant, long lasting benefits for these communities.

Beyond the necessity of tackling climate change for human prosperity and wellbeing, 2022 has also made clear the benefits of decarbonisation to address geopolitical risks for countries. Whether it is food shortages, energy security risks or extreme weather events and the harms they cause, climate change is amplifying the risks that all countries face. This recognition further strengthens the impetus for countries to rapidly decarbonise.

COP27 presents a vital moment for countries to show how they will close the gap to a 1.5°C pathway in both their emissions reduction pledges and plans to implement them.

THE SCIENTIFIC CASE FOR URGENT EMISSIONS REDUCTIONS

- The Intergovernmental Panel on Climate Change (IPCC) identifies pathways to 1.5°C with limited overshoot as requiring CO_2 emissions to peak by 2025, with **net zero CO_2 globally achieved between 2050 and 2055**, along with deep reductions in other GHGs. The remaining carbon budget to meet the 1.5°C target was assessed to be 500 $GtCO_2$ from the beginning of 2020. The remaining carbon budget for a 50% likelihood of limiting global warming to 1.5°C has now reduced to 420 $GtCO_2$ from the beginning of 2022, equivalent to 11 years of constant 2021 emissions levels[5]. Continued emissions during 2022 mean this remaining carbon budget will be smaller still from 2023.
- Current mitigation policies lead to around 58 $GtCO_2e$[a] emissions in 2030 and leave the world on track for approx 2.8°C of warming. Countries' Nationally Determined Contributions (NDCs), if met, would reduce 2030 emissions by 3-6 $GtCO_2e$, but are still not enough to be considered on-track to meet the Paris Agreement goals.[6] In a best-case outcome of NDCs being met, along with additional net-zero targets, 2100 global temperatures may be kept to 1.8°C above pre-industrial levels.
- The United Nations Environment Programme 2022 Emissions Gap report shows almost all countries are also far from setting NDCs that are sufficient to achieve the Paris Agreement targets.[7] The gap between countries' stated NDCs and what is required for 2030 is 15 $GtCO_2e$ annually, for a 2°C pathway, and 23 $GtCO_2e$ for a 1.5°C pathway, for a 66% chance of staying below the temperature limited and assuming full implementation of the unconditional NDCs.
- Updated NDCs that put the world on a pathway to limit warming to 1.5°C, as agreed in the Paris Agreement and reaffirmed in the COP26 Glasgow Climate Pact, are urgently needed from those countries that have not yet submitted them. Only with renewed commitment to meet existing and strengthened pledges can the Paris Agreement goals be kept alive.
- The window of opportunity to achieve 1.5°C with limited overshoot is closing rapidly, but pathways exist to achieve it. Early mitigation action brings benefits in both near-term, such as to air quality and global temperature,[8] and long-term, through limiting the extent of centennial commitments to ongoing sea-level rise.[9]

MITIGATION SOLUTIONS ACROSS SECTORS

- **To achieve net zero emissions targets,** which as of October 2022 covered 91% of global GDP[15], requires the overall balance between emissions across sectors to sum to zero. Approximately 73% of global emissions are associated with energy (including energy use for industry, transport and buildings). The remainder are split between agriculture and land use (19%), industry (5%) and waste (3%).[16]

a The metric of $GtCO_2e$ refers to a comparison between emissions from various greenhouse gases on the basis of their global-warming potential (GWP100). It converts amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

CASE STUDY: MITIGATION MATTERS TO THE OCEAN

A healthy and biodiverse ocean provides food, wellbeing, cultural heritage, and support for the sustainable livelihoods of billions of people – as well as a wealth of mitigation and adaptation options for climate change.[10]

The ocean plays a critical role in supporting life on Earth and in buffering climate change through uptake of excess heat energy, CO_2 and melted water.[11] However, the ocean has also warmed, acidified, and lost oxygen, whilst circulation patterns are changing, and sea levels are rising. The continuation of these climate-induced multiple changes represents existential threats to marine ecosystems, the future ability of the ocean to indirectly support all life on Earth and the effectiveness of the numerous ocean-based adaptation options.[12,13]

At COP27, all countries must recognise the importance of, and take urgent action on, mitigation through the rapid and near-term reduction in greenhouse gas emissions to limit global warming to near 1.5oC, as this is the only way to decrease global scale impacts on the ocean, enable more successful adaptation and benefit its ecosystems and all of society.[14]

- **Achieving ambitious mitigation pathways to stay within 1.5°C** with limited overshoot requires reduced demand through energy efficiency as well as emissions reductions from all sectors.[17] Opportunities exist especially in land-based mitigation, such as through reduced deforestation, and electricity generation, due to rapidly falling costs of renewable energy.[18,19] The IPCC's Sixth Assessment Report also identified urban areas as a key sector: an increasing share of emissions can be attributed to urban areas, but they also offer substantial synergies between sustainable development and energy efficiency through urban planning and infrastructure design.[20]
- Some sectors, such as cement production and aviation, are difficult sectors to decarbonise and it is likely that these will have positive emissions balances at the time that net zero targets must be realised; these sectors must be balanced by other removal of emissions, such as through forestry and engineered removals, to achieve net zero overall. The majority of sectors, including energy use for buildings and surface transport, **face requirements for very steep reductions in their emissions, without any time to delay.**
- To achieve net zero emissions by 2050, **existing fossil fuels will need to be phased out,** and no new oil or gas fields, or coal power stations or mines, should be approved, according to the International Energy Agency.[21] To stay within the Paris Agreement target of 1.5°C, existing global oil and gas production and consumption must also decrease by at least 65% by 2050[22], and unabated coal-fired power plants must be phased out by mid-century.[23]
- **There has been significant progress in the development of climate mitigation technologies.** For example, between 2010 to 2019, the cost of solar energy has fallen by 85%, wind energy by 55%, and lithium-ion batteries by 85%.[24] However, in some cases technological innovation risks leading to trade-offs for sustainable development. To avoid such risks, a systemic approach must be taken in order to prioritise the roll-out and combination of technological innovations. For example, in South America, agroecological mitigation approaches have been adopted to ensure that technological innovation is appropriate for the social, economic and ecological environment.[25]
- Effective deployment of climate mitigation technology must take place within a set of enabling conditions that includes access to appropriate infrastructure, supply chains, skills, education and capacity-building for people and workers, institutional support, as well as consistent and clear policy direction from Governments. Technology-push policies and investments (e.g. scientific training, R&D), as well as demand-pull policies (e.g. legislation, standards, taxes) are key to support the development of climate mitigation technologies.[26] **It is also essential that international cooperation supports the sharing of climate mitigation technologies** to low-and middle income countries, in order to maximise socioeconomic and environmental benefits.[27]

- Technological innovation alone is not sufficient to realise climate mitigation targets. **A transformation in social, economic and behavioural systems is also needed to facilitate a rapid reduction of emissions.** Most of the measures required to reach net zero emissions will require behaviour change by citizens and businesses[28]; indeed, around one-third of emissions reductions in a country like the UK will need to come from changing consumers' behaviour, such as from reducing car use and flying; changing diets; and cutting waste.[29] Behaviour change to reach net zero will require support through economic, regulatory and informational policies that remove cost, convenience and social barriers.
- Policy interventions aimed at incentivising effective mitigation strategies will need to recognise the systemic nature of climate change[30]. The actions of different societal actors are interdependent, and the effects of interventions spread nonlinearly through society. For example, policies that regulate firms' carbon budgets can stimulate the development of new products, which in turn can change consumers' preferences. Policymakers will need to employ **system thinking as a tool to encourage the adoption of effective mitigation strategies.**[31]

A JUST TRANSITION TO NET ZERO EMISSIONS

- **Pathways towards low-carbon futures must be fair, affordable and leave no-one behind.** A just transitions approach must apply to both mitigation and adaptation solutions. This is a long-standing challenge for climate action, compounded by the need to address the crisis across all global economies, promoting equity within economies and between high- and low-and-middle income countries.[32,33]
- Societal change to reach net zero is both possible and desirable: **climate action significantly enhances wellbeing, and helps achieve wider environmental, social and economic goals.** Communicating the many co-benefits of climate change mitigation – such as lower energy bills, improved air quality, energy security, and green jobs – can augment public, business and political support for the changes required.[34]
- **Climate finance will play a crucial role in helping low-and middle income countries both mitigate and adapt to climate shocks,** and support actions to address the climate-related losses and damages those countries have already, and will continue to, experience. In 2009, high-income countries agreed to mobilise $100 billion in climate finance per year by 2020. However, despite efforts to scale up support, the $100 billion goal was not met. COP27 should see high-income countries honour the pledge, and agree further finance post-2025.[35] Industrialised countries must honour the pledge at COP27.
- Catalysing the finance needed for resilience, adaptation and loss and damage will require trillions of dollars. Estimates suggest developing countries excluding China will need an additional $8 billion in climate finance by 2025, and close to $2 trillion per year by 2030. While half the resources required could come from domestic tax and subsidy reform, additional international climate finance will be necessary.[36] **Action on climate finance does not only require new public finance resources, but also a change in the rules governing the financial system** to factor climate-related physical and transition risk, as well as biodiversity loss, into decision-making.
- **Private and public action will be necessary to end financial support for fossil fuels and responsibly phase-out existing assets.**[37] In addition to phasing out support for fossil fuels and directing investment toward green innovation, there is a role for carbon pricing to internalise the environmental externality caused by pollution, redirect economic activity to low carbon sources and support the fiscal revenues that are needed to deliver a just transition.

REFERENCES

1. IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.
2. IPCC, 2018: Summary for Policymakers. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.
3. IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.00
4. IPCC, 2019: Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.
5. Friedlingstein et al. (2021). Global Carbon Budget 2021. Earth Syst. Sci. Data, 14, 1917–2005.
6. United Nations Environment Programme (2022). Emissions Gap Report 2022: The Closing Window — Climate crisis calls for rapid transformation of societies. Nairobi. www.unep.org/emissions-gap-report-2022
7. United Nations Environment Programme (2022). Emissions Gap Report 2022: The Closing Window — Climate crisis calls for rapid transformation of societies. Nairobi. www.unep.org/emissions-gap-report-2022
8. IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3–32, doi:10.1017/9781009157896.001.
9. Arias, P.A., N. Bellouin, E. Coppola, R.G. Jones, G. Krinner, J. Marotzke, V. Naik, M.D. Palmer, G.-K. Plattner, J. Rogelj, M. Rojas, J. Sillmann, T. Storelvmo, P.W. Thorne, B. Trewin, K. Achuta Rao, B. Adhikary, R.P. Allan, K. Armour, G. Bala, R. Barimalala, S. Berger, J.G. Canadell, C. Cassou, A. Cherchi, W. Collins, W.D. Collins, S.L. Connors, S. Corti, F. Cruz, F.J. Dentener, C. Dereczynski, A. Di Luca, A. Diongue Niang, F.J. Doblas-Reyes, A. Dosio, H. Douville, F. Engelbrecht, V. Eyring, E. Fischer, P. Forster, B. Fox-Kemper, J.S. Fuglestvedt, J.C. Fyfe, N.P. Gillett, L. Goldfarb, I. Gorodetskaya, J.M. Gutierrez, R. Hamdi, E. Hawkins, H.T. Hewitt, P. Hope, A.S. Islam, C. Jones, D.S. Kaufman, R.E. Kopp, Y. Kosaka, J. Kossin, S. Krakovska, J.-Y. Lee, J. Li, T. Mauritsen, T.K. Maycock, M. Meinshausen, S.-K. Min, P.M.S. Monteiro, T. Ngo-Duc, F. Otto, I. Pinto, A. Pirani, K. Raghavan, R. Ranasinghe, A.C. Ruane, L. Ruiz, J.-B. Sallée, B.H. Samset, S. Sathyendranath, S.I. Seneviratne, A.A. Sörensson, S. Szopa, I. Takayabu, A.-M. Tréguier, B. van den Hurk, R. Vautard, K. von Schuckmann, S. Zaehle, X. Zhang, and K. Zickfeld, 2021: Technical Summary. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 33–144, doi:10.1017/9781009157896.002.
10. UNFCCC, 2022. Subsidiary Body for Scientific and Technological Advice (SBSTA). The Ocean and Climate Change Dialogue 2022 informal summary report 27 Sep 2022. https://unfccc.int/documents/615101
11. Turley, C., Racault, M.-F., Roberts, J.M., Scott, B.E., Sharples, J., Thiele, T., Williams, R.G. and Williamson P. (2021). Why the Ocean Matters in Climate Negotiations. COP26 Universities Network Briefing. www.gla.ac.uk/media/Media_795093_smxx.pdf
12. IPCC, 2019. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. (Eds: Pörtner, H.-O. et al.,). www.ipcc.ch/srocc/home/.

13. IPCC, 2022: Summary for Policymakers [Eds: H.-O. Pörtner et al]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3-33, doi:10.1017/9781009325844.001.
14. UNFCCC, 2022. Subsidiary Body for Scientific and Technological Advice (SBSTA). The Ocean and Climate Change Dialogue 2022 informal summary report 27 Sep 2022. https://unfccc.int/documents/615101
15. Net Zero Tracker. (2022). Available at URL: https://zerotracker.net/
16. Ritchie, H., Roser, M., and Rosado, P. (2020) – "CO_2 and Greenhouse Gas Emissions". Available at URL: 'https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions'
17. IPCC, 2018: Summary for Policymakers. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.
18. IPCC, 2019: Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.
19. IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.00
20. IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001
21. IEA (2021). Net Zero by 2050. IEA, Paris. www.iea.org/reports/net-zero-by-2050
22. IISD. (2021). Navigating Energy Transitions Mapping the road to 1.5°C. Available at: www.iisd.org/publications/report/navigating-energy-transitions
23. Climate Analytics (2016). Implications of the Paris Agreement for Coal Use in the Power Sector. Available at: https://climateanalytics.org/media/climateanalytics-coalreport_nov2016_1.pdf
24. IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001
25. IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926
26. Costantini, V., Crespi, F., Martini, C., & Pennacchio, L. (2015). Demand-pull and technology-push public support for eco-innovation: The case of the biofuels sector. Research Policy, 44(3), 577-595. IPCC. (2022).
27. Dechezleprêtre, A., Glachant, M., Haščič, I., Johnstone, N., & Ménière, Y. (2011). Invention and transfer of climate change–mitigation technologies: a global analysis. Review of environmental economics and policy.
28. IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001
29. House of Lords Environment and Climate Change Committee (2022) In our hands: behaviour change for climate and environmental goals. Available at: https://committees.parliament.uk/publications/30146/documents/174873/default/
30. Voulvoulis, N., Giakoumis, T., et al. (2022) Systems thinking as a paradigm shift for sustainability transformation. Global Environmental Change 75, 102544
31. Ramos, G., & Hynes, W. (2019) Systemic thinking for policy making–the potential of systems analysis for addressing global policy challenges in the 21st century. Available at URL: www.oecd. org/naec/averting-systemic-collapse/SG-NAEC

32. Fankhauser, S., Smith, S.M., Allen, M. et al. The meaning of net zero and how to get it right. Nat. Clim. Chang. 12, 15–21 (2022). https://doi.org/10.1038/s41558-021-01245-w
33. Abram, S., Atkins, E., Dietzel, A., Hammond, M., Jenkins, K., Kiamba, L., Kirshner, J., Kreienkamp, J., Pegram, T. and Vining, B. (2020). Just Transition: Pathways to Socially Inclusive Decarbonisation. COP26 Universities Network Briefing. Available at: www.gla.ac.uk/media/Media_758106_smxx.pdf
34. Creutzig, F., Niamir, L., Bai, X. et al. Demand-side solutions to climate change mitigation consistent with high levels of well-being. Nat. Clim. Chang. 12, 36–46 (2022). https://doi.org/10.1038/s41558-021-01219-y
35. Heubaum, H., Jackson, F., Omukuti, J., Seega, N. and Zalewska, A. (2021) Aligning Climate Finance for an Equitable and Sustainable Net Zero Future. COP26 Universities Network Briefing. Available at: www.gla.ac.uk/media/Media_818883_smxx.pdf
36. Bhattacharya, A. and Stern, N. (2021). Beyond the $100 billion: financing a sustainable and resilient future. Grantham Research Institute on Climate Change and the Environment Policy Note. London School of Economics and Political Science.
37. IEA (2021). Net Zero by 2050. IEA, Paris. www.iea.org/reports/net-zero-by-2050

This briefing is produced in association with the UK Universities Climate Network, a growing group of more than 80 UK-based universities and research centres working together to help drive climate action.

The briefing represents the views of its authors and not necessarily that of every University or institution participating in the network. For more information about the UK Universities Climate Network, please contact ukclimateuniversities@imperial.ac.uk

HOW TO CITE THIS BRIEFING:

Abdelrehim, N., Cenci, S., Corsini, L., Dixon, J., Jones, C., Khanna, S., Mathison, C., Petersen, K. T., Turley, C., Whitmarsh, L. (2022). The Urgency of Climate Mitigation for COP27 and Beyond. *UK Universities Climate Network Briefing.*