2022-IP03: IPCC approves the Summary for Policymakers for Working Group III "Mitigation of Climate Change"

Briefly

After five years of work, the Working Group III of the Intergovernmental Panel on Climate Change released its report contributing to the Sixth Assessment process. The report is released several hours later than scheduled. Scientists, technologists, economists, policymakers and government negotiators worked late into Sunday to complete the review and line-by-line approval process of the Summary for Policymakers. The SPM came in at 37 pages, summarizing 3,670 pages of the underlying report "Mitigation of Climate Change." The Mitigation report covers a wide range of assessments of the literature on energy and greenhouse gas control technologies, policies, economics, stakeholders and governance issues around the world, and even more recently legal issues.

I played dual roles, serving as one of two official Review Editors of Chapter 6 'Energy Systems,' serving with my colleague Joseph Essandoh-Yeddu, a Ghanaian government official with expertise in the electricity sector.

During the plenary review and negotiations, I was also an official observer for IPIECA, the global oil and gas industry association focused on advancing environmental and social performance of the industry. which was formed in 1974 as the official channel of communications and observer to the United Nations system. IPIECA then formed the Climate Change Group in 1988 when the World Meteorological Organization and the United Nations Environment Programme, two U.N. specialist agencies, formed a third process, the Intergovernmental Panel on Climate Change also in 1988.

I served as Review Editor in the Special Report of the Carbon Dioxide Capture and Storage Report (IPCC SRCCS, 2005) and a contributing author of geothermal energy in the IPCC Special Report on Renewable Energy Sources and Climate Change (SRREN, 2011).

This excerpt is from the press release accompanying the launch of the report by Working Group III. In a heading labeled in bold as "**The next few years are critical**," the IPCC press release states these two paragraphs. Jim Skea, quoted in these statements, is professor at Imperial College London and is the co-chair of Working Group III who facilitated the entire SPM review and negotiations process.

"…In the scenarios we assessed, limiting warming to around 1.5°C (2.7°F) requires global greenhouse gas emissions to peak before 2025 at the latest, and be reduced by 43% by 2030; at the same time, methane would also need to be reduced by about a third. Even if we do this, it is almost inevitable that we will temporarily exceed this temperature threshold but could return to below it by the end of the century. "It's now or never, if we want to limit global warming to 1.5°C (2.7°F)," said Skea. "Without immediate and deep emissions reductions across all sectors, it will be impossible." "

"The global temperature will stabilise when carbon dioxide emissions reach net zero. For 1.5°C (2.7°F), this means achieving net zero carbon dioxide emissions globally in the early 2050s; for 2°C (3.6°F), it is in the early 2070s. This assessment shows that limiting warming to around 2°C (3.6°F) still requires global greenhouse gas emissions to peak before 2025 at the latest, and be reduced by a quarter by 2030."

In additional excerpts, the press release in the section labeled '**We have options in all sectors to at least halve emissions by 2030**,' made clear that the report stated several themes about the critical importance of reducing emissions deeply soon from all sectors of the economy. Jim Skea is again quoted. His co-chair counterpart, Professor Priyadarshi Shukla (India) is also quoted.

'… Limiting global warming will require major transitions in the energy sector. This will involve a substantial reduction in fossil fuel use, widespread electrification, improved energy efficiency, and use of alternative fuels (such as hydrogen). '

' "Having the right policies, infrastructure and technology in place to enable changes to our lifestyles and behaviour can result in a 40-70% reduction in greenhouse gas emissions by 2050. This offers significant untapped potential," said IPCC Working Group III Co-Chair Priyadarshi Shukla. "The evidence also shows that these lifestyle changes can improve our health and wellbeing." '

'Cities and other urban areas also offer significant opportunities for emissions reductions. These can be achieved through lower energy consumption (such as by creating compact, walkable cities), electrification of transport in combination with low-emission energy sources, and enhanced carbon uptake and storage using nature. There are options for established, rapidly growing and new cities.'

The Summary for Policymakers can be downloaded via this link.

The full report, Working Group III contribution to the Sixth Assessment Report, "Mitigation of Climate Change," can be downloaded via this link

Detailed excerpts and graphics

Section A of the Summary for Policymakers is an introductory section focused on explaining the role of the various recent assessment reports and the wide range of literature that were assessed. The IPCC stated, in part:

"**Increasing diversity of actors and approaches to mitigation.** Recent literature highlights the growing role of non-state and sub-national actors including cities, businesses, Indigenous Peoples, citizens including local communities and youth, transnational initiatives, and public-private entities in the global effort to address climate change. Literature documents the global spread of climate policies and cost declines of existing and emerging low emission technologies, along with varied types and levels of mitigation efforts, and sustained reductions in greenhouse gas (GHG) emissions in some countries, and the impacts of, and some lessons from, the COVID-19 pandemic."

There was also a description in Section A about "**Close linkages between climate change mitigation adaptation and development pathways**."

"The development pathways taken by countries at all stages of economic development impact GHG emissions and hence shape mitigation challenges and opportunities, which vary across countries and regions. Literature explores how development choices and the establishment of enabling conditions for action and support influence the feasibility and the cost of limiting emissions. Literature highlights that climate change mitigation action designed and conducted in the context of sustainable development, equity, and poverty eradication, and rooted in the development aspirations of the societies within which they take place, will be more acceptable, durable and effective. This report covers mitigation from both targeted measures, and from policies and governance with other primary objectives."

Working Group III has also taken on new assessments of more literature.

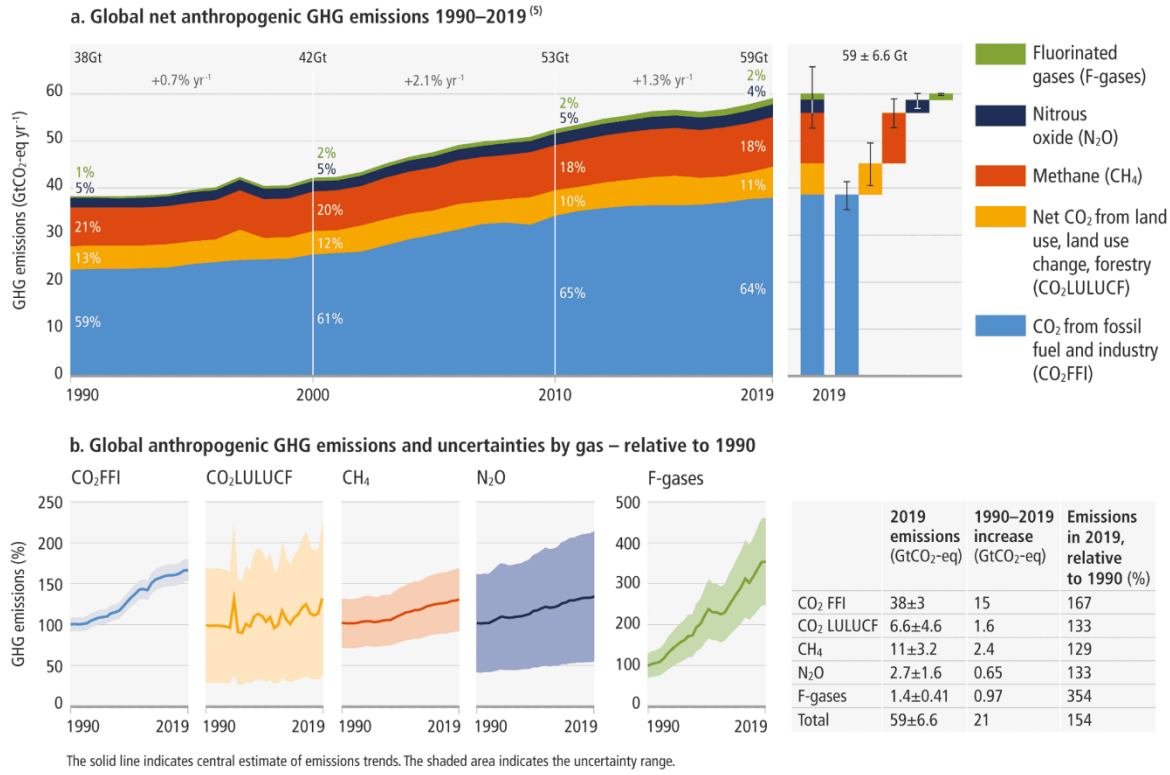
"**New approaches in the assessment.** In addition to the sectoral and systems chapters {3, 6, 7, 8, 9, 10, 11, 12}, the report includes, for the first time in a WG III report, chapters dedicated to demand for services, and social aspects of mitigation {5, Box TS.11}, and to innovation, technology development and transfer {16}. The assessment of future pathways in this report covers near term

(to 2030), medium term (up to 2050), and long term (to 2100) timescales, combining assessment of existing pledges and actions {4, 5}, with an assessment of emissions reductions, and their implications, associated with long-term temperature outcomes up to the year 2100 {3}. The assessment of modelled global pathways addresses ways of shifting development pathways towards sustainability. …"

Then I excerpted twenty-five headline statements from the Summary for Policymakers that were most interesting to me. I retained the section numbers so that you can readily identify them when you read the SPM yourself.

"B.1 Total net anthropogenic GHG emissions have continued to rise during the period 2010–2019, as have cumulative net CO2 emissions since 1850. Average annual GHG emissions during 2010-2019 were higher than in any previous decade, but the rate of growth between 2010 and 2019 was lower than that between 2000 and 2009." See Figure SPM.1.

Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.



	2019 emissions ($GtCO_2$-eq)	1990–2019 increase ($GtCO_2$-eq)	Emissions in 2019, relative to 1990 (%)
CO_2 FFI	38±3	15	167
CO_2 LULUCF	6.6±4.6	1.6	133
CH_4	11±3.2	2.4	129
N_2O	2.7±1.6	0.65	133
F-gases	1.4±0.41	0.97	354
Total	59±6.6	21	154

The solid line indicates central estimate of emissions trends. The shaded area indicates the uncertainty range.

"B.2 Net anthropogenic GHG emissions have increased since 2010 across all major sectors globally. An increasing share of emissions can be attributed to urban areas. Emissions reductions in CO2 from fossil fuels and industrial processes, due to improvements in energy intensity of GDP and carbon intensity of energy, have been less than emissions increases from rising global activity levels in industry, energy supply, transport, agriculture and buildings."

"B.3 Regional contributions to global GHG emissions continue to differ widely. Variations in regional, and national per capita emissions partly reflect different development stages, but they also vary widely at similar income levels. The 10% of households with the highest per capita emissions contribute a disproportionately large share of global household GHG emissions. At least countries have sustained GHG emission reductions for longer than 10 years."

“B.4 The unit costs of several low-emission technologies have fallen continuously since 2010. Innovation policy packages have enabled these cost reductions and supported global adoption. Both tailored policies and comprehensive policies addressing innovation systems have helped overcome the distributional, environmental and social impacts potentially associated with global diffusion of low-emission technologies. Innovation has lagged in developing countries due to weaker enabling conditions. Digitalisation can enable emission reductions, but can have adverse side-effects unless appropriately governed.” See Figure SPM.3.

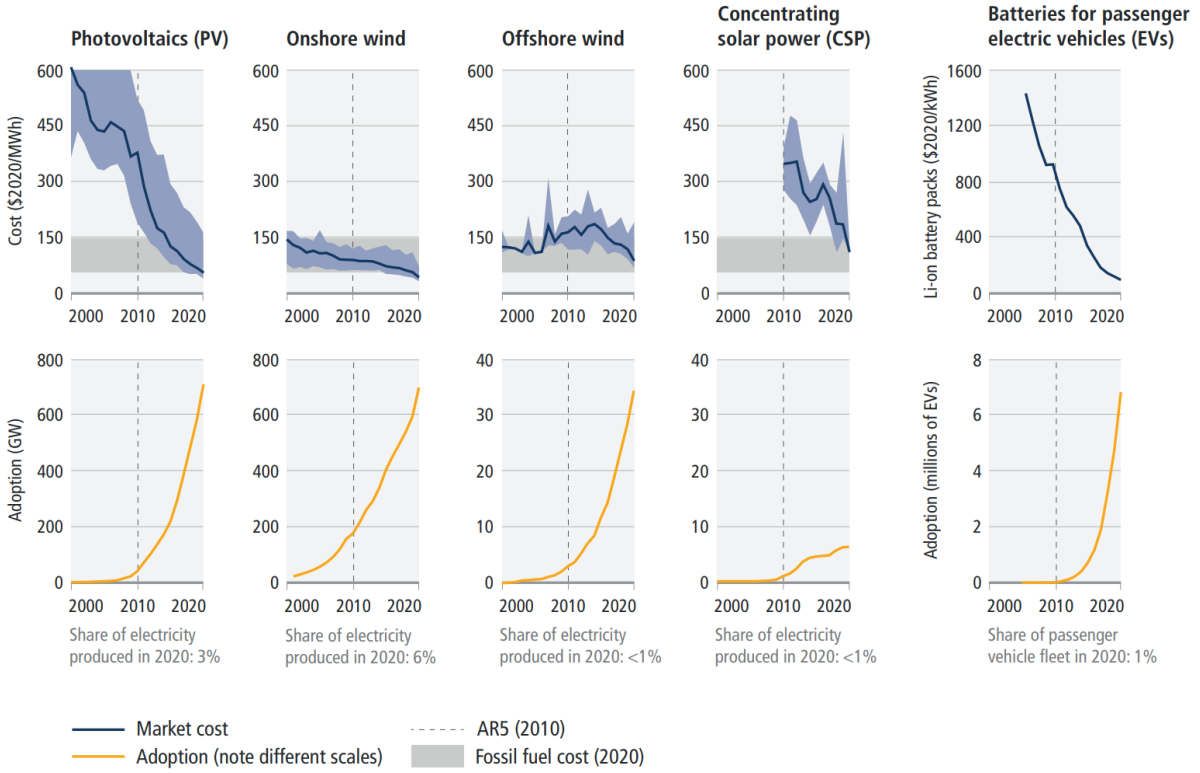


Figure SPM.3: Unit cost reductions and use in some rapidly changing mitigation technologies

“The top panel shows global costs per unit of energy (USD/MWh) for some rapidly changing mitigation technologies. Solid blue lines indicate average unit cost in each year. Light blue shaded areas show the range between the 5th and 95th percentiles in each year. Grey shading indicates the range of unit costs for new fossil fuel (coal and gas) power in 2020 (corresponding to USD55–148 per MWh). In 2020, the levelized costs of energy (LCOE) of the four renewable energy technologies could compete with fossil fuels in many places. For batteries, costs shown are for 1 kWh of battery storage capacity; for the others, costs are LCOE [levelized cost of electricity], which includes installation, capital, operations, and maintenance costs per MWh of electricity produced. The literature uses LCOE because it allows consistent comparisons of cost trends across a diverse set of energy technologies to be made. However, it does not include the costs of grid integration or climate impacts. Further, LCOE does not take into account other environmental and social externalities that may modify the overall (monetary and non-monetary) costs of technologies and alter their deployment.”

“The bottom panel shows cumulative global adoption for each technology, in GW of installed capacity for renewable energy and in millions of vehicles for battery-electric vehicles. A vertical dashed line is placed in 2010 to indicate the change since AR5. Shares of electricity produced and share of passenger vehicle fleet are indicated in text for 2020 based on provisional data, i.e., percentage of total electricity production (for PV, onshore wind, offshore wind, CSP) and of total

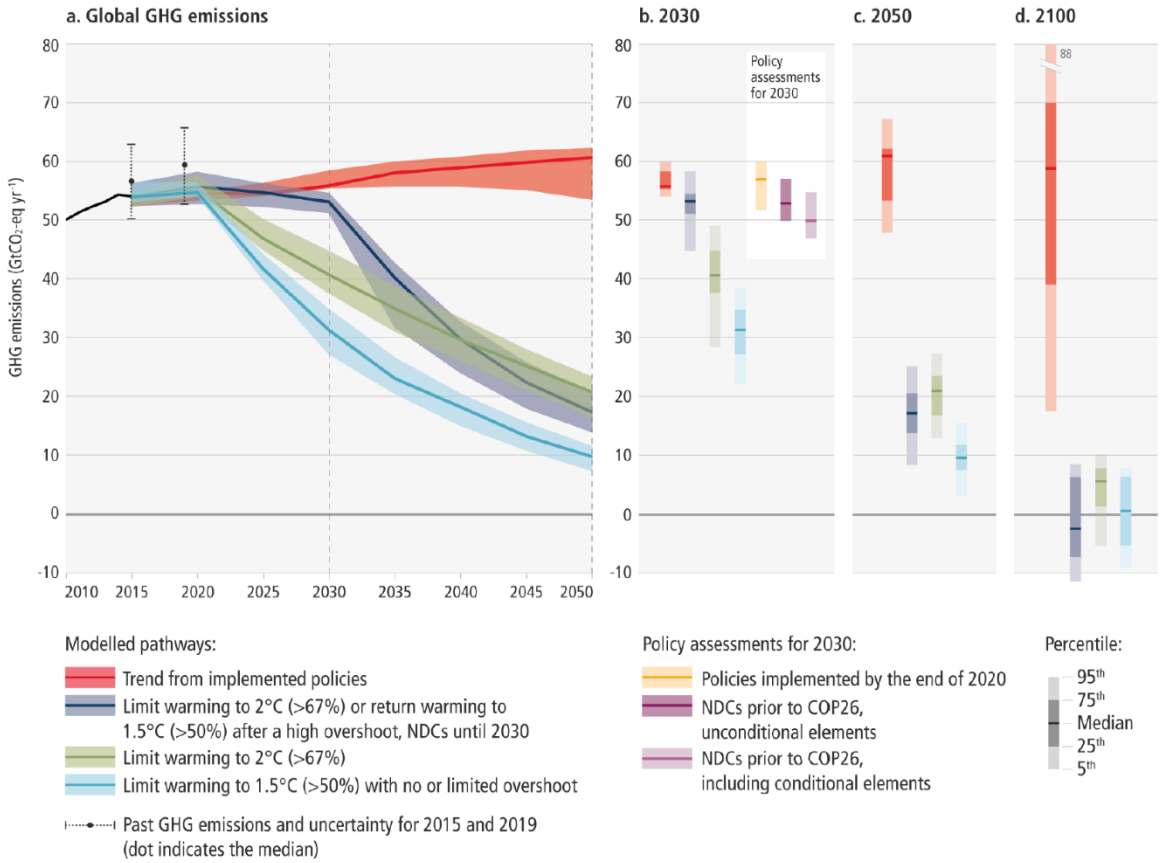
stock of passenger vehicles (for electric vehicles). The electricity production share reflects different capacity factors; e.g., for the same amount of installed capacity, wind produces about twice as much electricity as solar PV."

"Renewable energy and battery technologies were selected as illustrative examples because they have recently shown rapid changes in costs and adoption, and because consistent data are available. Other mitigation options assessed in the report are not included as they do not meet these criteria."

"B5. There has been a consistent expansion of policies and laws addressing mitigation since AR5. This has led to the avoidance of emissions that would otherwise have occurred and increased investment in low-GHG technologies and infrastructure. Policy coverage of emissions is uneven across sectors. Progress on the alignment of financial flows towards the goals of the Paris Agreement remains slow and tracked climate finance flows are distributed unevenly across regions and sectors."

"B.6 Global GHG emissions in 2030 associated with the implementation of nationally determined contributions (NDCs) announced prior to COP26 would make it likely that warming will exceed 1.5°C during the 21st century. Likely limiting warming to below 2°C would then rely on a rapid acceleration of mitigation efforts after 2030. Policies implemented by the end of 2020 are projected to result in higher global GHG emissions than those implied by NDCs." See Figure SPM.4 (below).

Projected global GHG emissions from NDCs announced prior to COP26 would make it likely that warming will exceed 1.5°C and also make it harder after 2030 to limit warming to below 2°C.

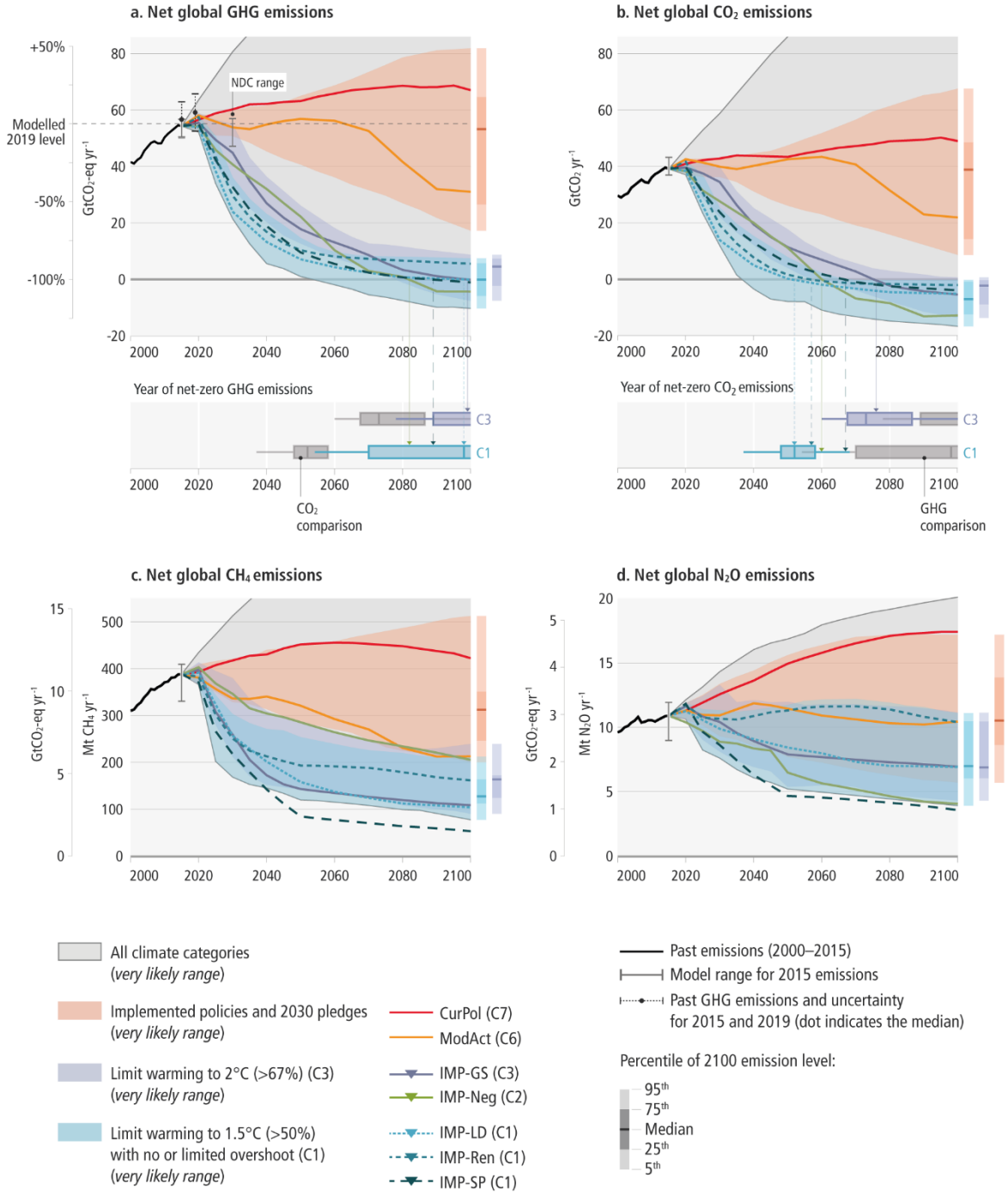


"C.1 Global GHG emissions are projected to peak between 2020 and at the latest before 2025 in global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot and in those that limit warming to 2°C (>67%) and assume immediate action. In both types of modelled

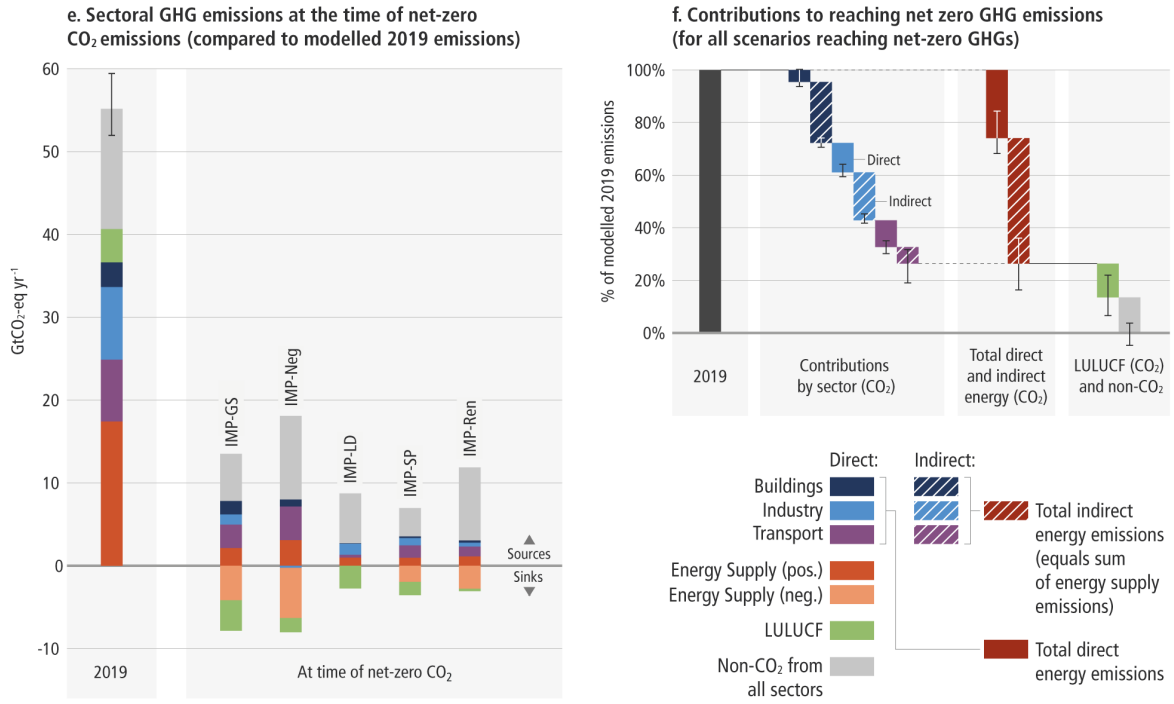
pathways, rapid and deep GHG emissions reductions follow throughout 2030, 2040 and 2050. Without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2 [2.2 to 3.5] °C by 2100."

"C.3 All global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and those that limit warming to 2°C (>67%) involve rapid and deep and in most cases immediate GHG emission reductions in all sectors. Modelled mitigation strategies to achieve these reductions include transitioning from fossil fuels without CCS to very low- or zero-carbon energy sources, such as renewables or fossil fuels with CCS, demand side measures and improving efficiency, reducing non-CO_2 emissions, and deploying carbon dioxide removal (CDR) methods to counterbalance residual GHG emissions. Illustrative Mitigation Pathways (IMPs) show different combinations of sectoral mitigation strategies consistent with a given warming level. (Figure SPM.5, two panels)" See the Figure below, separated into two panels."

Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.



Net zero CO_2 and net zero GHG emissionsare possible through different modelled mitigation pathways.



"C.4 Reducing GHG emissions across the full energy sector requires major transitions, including a substantial reduction in overall fossil fuel use, the deployment of low-emission energy sources, switching to alternative energy carriers, and energy efficiency and conservation. The continued installation of unabated fossil fuel infrastructure will 'lock-in' GHG emissions."

"C.5 Net-zero CO_2 emissions from the industrial sector are challenging but possible. Reducing industry emissions will entail coordinated action throughout value chains to promote all mitigation options, including demand management, energy and materials efficiency, circular material flows, as well as abatement technologies and transformational changes in production processes. Progressing towards net zero GHG emissions from industry will be enabled by the adoption of new production processes using low and zero GHG electricity, hydrogen, fuels, and carbon management."

"C.8 Demand-side options and low-GHG emissions technologies can reduce transport sector emissions in developed countries and limit emissions growth in developing countries. Demand-focused interventions can reduce demand for all transport services and support the shift to more energy efficient transport modes. Electric vehicles powered by low emissions electricity offer the largest decarbonisation potential for land-based transport, on a life cycle basis. Sustainable biofuels can offer additional mitigation benefits in land-based transport in the short and medium term. Sustainable biofuels, low emissions hydrogen, and derivatives (including synthetic fuels) can support mitigation of CO2 emissions from shipping, aviation, and heavy-duty land transport but require production process improvements and cost reductions. Many mitigation strategies in the transport sector would have various co-benefits, including air quality improvements, health benefits, equitable access to transportation services, reduced congestion, and reduced material demand."

"C.9 AFOLU [agriculture, forestry, and other land use] mitigation options, when sustainably implemented, can deliver large-scale GHG emission reductions and enhanced removals, but cannot fully compensate for delayed action in other sectors. In addition, sustainably sourced agricultural

and forest products can be used instead of more GHG intensive products in other sectors. Barriers to implementation and trade-offs may result from the impacts of climate change, competing demands on land, conflicts with food security and livelihoods, the complexity of land ownership and management systems, and cultural aspects. There are many country-specific opportunities to provide co-benefits (such as biodiversity conservation, ecosystem services, and livelihoods) and avoid risks (for example, through adaptation to climate change)."

"C.10 Demand-side mitigation encompasses changes in infrastructure use, end-use technology adoption, and socio-cultural and behavioural change. Demand-side measures and new ways of end-use service provision can reduce global GHG emissions in end use sectors by 40-70% by 2050 compared to baseline scenarios, while some regions and socioeconomic groups require additional energy and resources. Demand side mitigation response options are consistent with improving basic wellbeing for all."

"C.12 Mitigation options costing USD100 tCO_2-eq_{-1} or less could reduce global GHG emissions by at least half the 2019 level by 2030. Global GDP continues to grow in modelled pathways but, without accounting for the economic benefits of mitigation action from avoided damages from climate change nor from reduced adaptation costs, it is a few percent lower in 2050 compared to pathways without mitigation beyond current policies. The global economic benefit of limiting warming to 2°C is reported to exceed the cost of mitigation in most of the assessed literature."

"D.1 Accelerated and equitable climate action in mitigating, and adapting to, climate change impacts is critical to sustainable development. Climate change actions can also result in some trade-offs. The trade-offs of individual options could be managed through policy design. The Sustainable Development Goals (SDGs) adopted under the UN 2030 Agenda for Sustainable Development can be used as a basis for evaluating climate action in the context of sustainable development."

"D.2 There is a strong link between sustainable development, vulnerability and climate risks. Limited economic, social and institutional resources often result in high vulnerability and low adaptive capacity, especially in developing countries. Several response options deliver both mitigation and adaptation outcomes, especially in human settlements, land management, and in relation to ecosystems. However, land and aquatic ecosystems can be adversely affected by some mitigation actions, depending on their implementation. Coordinated cross-sectoral policies and planning can maximise synergies and avoid or reduce trade-offs between mitigation and adaptation."

"D.3 Enhanced mitigation and broader action to shift development pathways towards sustainability will have distributional consequences within and between countries. Attention to equity and broad and meaningful participation of all relevant actors in decision-making at all scales can build social trust, and deepen and widen support for transformative changes."

"E.1 There are mitigation options which are feasible to deploy at scale in the near term. Feasibility differs across sectors and regions, and according to capacities and the speed and scale of implementation. Barriers to feasibility would need to be reduced or removed, and enabling conditions strengthened to deploy mitigation options at scale. These barriers and enablers include geophysical, environmental-ecological, technological, and economic factors, and especially institutional and socio-cultural factors. Strengthened near-term action beyond the NDCs (announced prior to UNFCCC COP26) can reduce and/or avoid long-term feasibility challenges of global modelled pathways that limit warming to 1.5 °C (>50%) with no or limited overshoot."

"E.2 In all countries, mitigation efforts embedded within the wider development context can increase the pace, depth and breadth of emissions reductions. Policies that shift development

pathways towards sustainability can broaden the portfolio of available mitigation responses, and enable the pursuit of synergies with development objectives. Actions can be taken now to shift development pathways and accelerate mitigation and transitions across systems."

"E.3 Climate governance, acting through laws, strategies and institutions, based on national circumstances, supports mitigation by providing frameworks through which diverse actors interact, and a basis for policy development and implementation. Climate governance is most effective when it integrates across multiple policy domains, helps realise synergies and minimize trade-offs, and connects national and sub-national policy-making levels. Effective and equitable climate governance builds on engagement with civil society actors, political actors, businesses, youth, labour, media, Indigenous Peoples and local communities."

"E.3.3 The extent to which civil society actors, political actors, businesses, youth, labour, media, Indigenous Peoples, and local communities are engaged influences political support for climate change mitigation and eventual policy outcomes. Structural factors of national circumstances and capabilities (e.g., economic and natural endowments, political systems and cultural factors and gender considerations) affect the breadth and depth of climate governance. Mitigation options that align with prevalent ideas, values and beliefs are more easily adopted and implemented. Climate-related litigation, for example by governments, private sector, civil society and individuals is growing, with a large number of cases in some developed countries, and with a much smaller number in some developing countries, and in some cases, has influenced the outcome and ambition of climate governance."

"E.4 Many regulatory and economic instruments have already been deployed successfully. Instrument design can help address equity and other objectives. These instruments could support deep emissions reductions and stimulate innovation if scaled up and applied more widely. Policy packages that enable innovation and build capacity are better able to support a shift towards equitable low-emission futures than are individual policies. Economy-wide packages, consistent with national circumstances, can meet short-term economic goals while reducing emissions and shifting development pathways towards sustainability."

"E.4.2 Economic instruments have been effective in reducing emissions, complemented by regulatory instruments mainly at the national and also sub-national and regional level. Where implemented, carbon pricing instruments have incentivized low-cost emissions reduction measures, but have been less effective, on their own and at prevailing prices during the assessment period, to promote higher-cost measures necessary for further reductions. Equity and distributional impacts of such carbon pricing instruments can be addressed by using revenue from carbon taxes or emissions trading to support low-income households, among other approaches. Practical experience has informed instrument design and helped to improve predictability, environmental effectiveness, economic efficiency, distributional goals and social acceptance. Removing fossil fuel subsidies would reduce emissions, improve public revenue and macroeconomic performance, and yield other environmental and sustainable development benefits; subsidy removal may have adverse distributional impacts especially on the most economically vulnerable groups which, in some cases can be mitigated by measures such as re-distributing revenue saved, all of which depend on national circumstances; fossil fuel subsidy removal is projected by various studies to reduce global CO_2 emissions by 1-4%, and GHG emissions by up to 10% by 2030, varying across regions."

"E.5 Tracked financial flows fall short of the levels needed to achieve mitigation goals across all sectors and regions. The challenge of closing gaps is largest in developing countries as a whole. Scaling up mitigation financial flows can be supported by clear policy choices and signals from governments and the international community. Accelerated international financial cooperation is a

critical enabler of low-GHG and just transitions, and can address inequities in access to finance and the costs of, and vulnerability to, the impacts of climate change."

"E.6 International cooperation is a critical enabler for achieving ambitious climate change mitigation goals. The UNFCCC, Kyoto Protocol, and Paris Agreement are supporting rising levels of national ambition and encouraging development and implementation of climate policies, although gaps remain. Partnerships, agreements, institutions and initiatives operating at the sub-global and sectoral levels and engaging multiple actors are emerging, with mixed levels of effectiveness."

Arthur Lee
Chevron Fellow and Principal Advisor
05/04/2022