TOPLINES: CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE

STILL HEADED THE WRONG WAY FAST

Emissions are growing at a slower rate, but the world remains far off target, with emissions and policies putting us on a pace well beyond 1.5°C. Current country *pledges* (through October 2021) would still take us well beyond 1.5°C, for all practical purposes eliminating the option of limiting warming to 1.5°C; current *policies and practice* would take us even further beyond 1.5°C – policies *implemented* by the end of 2020 had us on a path headed for 3.2°C.

The IPCC now considers it unlikely (only a 38% chance) that warming will be limited to 1.5°C (with no overshoot) when traveling the most ambitious pathway established in the literature. Instead, the global temperature increase on this path would most likely peak at 1.6°C and then ebb back down to 1.3°C this century. This change is due, in part, to the continued rise in emissions since the *1.5 Report* was released in 2018, at which time the IPCC assessed the likelihood of remaining below 1.5°C (with no overshoot) on the most ambitious pathway to be 55%.

This report establishes new emissions reductions targets based on 1.5°C and 2°C pathways. In order to limit warming to 1.5°C, global greenhouse gas emissions must peak by 2025.

- On a 1.5°C pathway, greenhouse gas emissions must drop by 43% from current (2019) levels by 2030 and 84% by 2050. Global carbon dioxide emissions must fall by 48% in 2030 and by 80% in 2040; methane emissions must fall by 34% by 2030 and 44% in 2040.
- For comparison, these are the emission benchmarks from the *1.5 Report* that noted CO_2 must be reduced 45% from 2010 levels by 2030, reaching net zero around 2050, and methane must be reduced 35% by 2050.
- There are significant economic upsides to reaching peak emissions by 2025. Achieving peak emissions sooner will require more up-front investment and rapid implementation of the energy transition, but will result in long-term economic benefits and avoid greater losses from climate change damage.

Operating even our current fossil fuel infrastructure puts 1.5°C out of reach.
The projected CO_2 emissions from existing and currently planned fossil fuel infrastructure exceeds any scenario in which 1.5°C remains possible. Continued installation and investment in fossil fuel infrastructure – unless fitted with expensive carbon capture technology – will lock-in emissions scenarios beyond warming targets. To avoid warming above 1.5°C, many existing fossil fuel power plants must be decommissioned, most planned fossil infrastructure canceled, and most fossil fuels phased out.

Fossil fuel infrastructure must be phased out in order to maintain the possibility of limiting warming to 1.5°C or to likely below 2°C.

- In scenarios where warming is limited to 2°C, the remaining CO_2 emissions come almost entirely from outside the power sector, primarily from difficult to decarbonize sectors such as industry and transportation.
- On a 1.5°C pathway, by 2050, there must be substantial declines in the use of coal (95%), oil (60%), and gas (45%).

Politics and status-quo interests – not science, money, or technology – remain the primary barriers to meeting climate targets.

On technological and cost considerations alone, mitigation of emissions to limit warming to 1.5°C is feasible. Barriers to implementation are frequently driven by politics and power relationships and status-quo interests blocking climate policies, including fossil fuel phaseout. Science misinformation, including from legacy and social media, is an obstacle.

Financial institutions and governments are still funding fossil fuels more than renewable energy. Meanwhile, funding of renewable energy falls well short of what's needed to achieve mitigation goals.

- Financial flows (public, private, domestic and international) across all sectors and regions are assessed to be a factor of three- to six-times too low where they must be by 2030 in order to limit warming to 2°C.
- Lack of capital is not the problem, there is sufficient global capital and liquidity to meet the need and close investment gaps. However this is impeded as commercial finance fails to adequately assess climate risks, leading to a mismatch between capital and investment needs, home biases, and limited institutional capacities.
- Stranded assets provide a further barrier to action due to pressure from countries, businesses, and individuals who stand to lose wealth from existing infrastructure to maintain such assets beyond their financial, social, and environmental utility.

Both the responsibility for global warming-causing emissions and the burden of climate change impacts are unequally distributed. Addressing inequality and focusing on wellbeing can support mitigation efforts.

Rich countries and high-income people are responsible for climate change, while least developed countries and poor people are least responsible for climate change but experience the worst impacts. The wealthiest individuals have the highest potential for emissions reductions.

- The top 10% of households by income are responsible for 34-45% of consumption-based greenhouse gas emissions, while the bottom 50% of households by income contribute 13-15% of emissions. High-consumption-based emitters (about two-thirds) are heavily concentrated in developed countries, and low-consumption-based emitters (about one third) live in developing countries.
- The report highlights North America as the greatest historical contributor to global greenhouse gas emissions and per-capita emissions.

A POLITICALLY TOUGH BUT CLEAR PATH FORWARD POWERED BY A REVOLUTION IN CLEAN ENERGY AND ELECTRIFICATION

Fossil fuel infrastructure can and should be phased out and replaced with electricity powered by renewables. A clean energy revolution since AR5 has made renewables cheap, cheaper often than fossil fuels.

- For many people in many places, installing new clean energy is cheaper than operating existing fossil-fuel energy, and often cheaper than installing new fossil fuel infrastructure.
- Mitigation options that could reduce emissions enough to limit warming to 1.5°C are very cheap. Options costing less than $20 per ton CO_2-equivalent could achieve half of the potential emissions reductions by 2030. The low cost of these options makes implementation more equitable in the U.S. and around the globe.
- Much existing fossil fuel infrastructure and uncancelled future infrastructure will become trillions of dollars in stranded assets.
- This marks a major shift by IPCC. In the prior Mitigation Report in 2014, fossil fuels were forecast to make up a major share of the energy mix, paired with carbon capture technology, going forward

Making deep and rapid cuts to methane emissions is critical to any path to limiting warming. All paths that limit warming to 1.5°C require rapid and deep cuts in methane emissions by 2030 and by 2050.

- Methane is projected to be the biggest remaining source of non-CO_2 greenhouse gas emissions (60%) at the time of global net zero CO_2 is reached.
- Due to the short lifetime of methane in the atmosphere, deep cuts in methane emissions can lower the peak global warming.
    - As expressed in the Working Group II *Adaptation* report, methane's role in avoiding every additional 0.1°C of warming is critical to avoiding worse impacts to people and ecosystems.
- Fugitive methane emissions from the production and transport of fossil fuels account for about 18% of energy supply emissions, 32% of global methane emissions and 6% of global greenhouse gas emissions. A significant percentage – 50-80% – could be avoided with available technology at relatively low cost.
- Methane emissions from agriculture, forestry and land use (AFOLU) are more difficult and more expensive to eliminate, although some emerging technologies in mitigating agricultural emissions show promise.

Electrify everything.

- Some countries have succeeded in achieving sustained reductions in consumption-based CO_2 emissions by decarbonizing the energy supply, improving efficiency of buildings and transport, and reducing overall energy demand.
- Future emissions reductions can be found in cost-efficient options such as shifting to renewable and zero-carbon energy sources, improving building efficiency and electrification and reducing energy demand, and electrifying transportation.

    - Retrofitted and new buildings could approach net zero greenhouse gas emissions by 2050 through policies that promote low-emissions design, construction, and use, including by using low-carbon construction materials and decarbonizing and decreasing energy consumption. The failure to implement ambitious policies to decarbonize building stock would result in locked-in carbon emissions for decades.
    - Electric vehicles powered and other vehicles by low-carbon electricity have the greatest emissions reduction potential for land-based transportation. Advances in battery technology could facilitate electrification of heavy-duty trucks and rail systems.

The economics from addressing climate change are a net positive for GDP. Fossil fuels are no longer the only or even most reliable

- The cost of limiting climate change to 1.5°C is minimal. The change to the annual growth in GDP in transitioning the global economy to renewables would be about 1/10th of 1% – smaller than a rounding error – relative to a fossil fueled economy, and before accounting for co-benefits and the major savings accrued by avoiding the damages driven by global warming over 1.5°C.
- Economic and monetary policies, including removing fossil fuel subsidies and instituting carbon pricing, have economic upsides beyond direct impact on emissions: It would improve public revenue and macroeconomic performance, support low income groups, and reap other environmental and sustainable development benefits.

Effective policy can succeed in driving mitigation. Public engagement can overcome institutional barriers to action.

- Ending fossil-fuel subsidies alone could reduce greenhouse gas emissions by as much as 10% by 2030.
- The success of a just energy transition relies on equity and inclusion, engagement with civil society, local and Indigenous communities, and other civil society groups to encourage buy-in, social trust, and promote policy outcomes that are appropriate across society.
- Tailored innovation policies can be credited with driving down the cost of low-emissions technologies including solar (85% from 2010-2019), wind (55%), lithium-ion batteries (85%), and deployment of those technologies.
- Publicly funded research and development, funding for demonstration projects, and instruments such as deployment of subsidies, have proven effective.
- Policies can support better consumer choices on sustainable and healthy diets, food waste reduction; heating, cooling and powering buildings; transportation; and sustainable consumption; leading to reduced wasteful demand that drives unnecessary carbon pollution.

Carbon dioxide removal will be an important stop gap for difficult-to-decarbonize sectors but must be done with care to prevent harmful socio-economic impacts.

- Carbon dioxide removal is needed to cover gaps in non-greenhouse gas emissions and in hard-to-decarbonize industries, including aviation, agriculture, and heavy industry. CDR deployment must be paired with absolute emission reductions.
- Poorly done CDR could backfire and have serious negative socio-economic side effects on people, including food security, and biodiversity. This highlights the importance of responsible deployment.
- The report finds that scaling up CDR requires research and development, targeted incentives, and robust accounting of carbon flow.

There are *niche* roles for alternative mitigation strategies.

- Carbon capture and storage (CCS) is distinct from carbon dioxide and has applications for some difficult-to-decarbonize sectors, such as manufacture of basic materials, steel, cement and plastics, and some power sector retrofits.
- Use of hydrogen for steel production is near ready for commercial use.
- Hydrogen and biofuels provide potential low-carbon options for transportation, including shipping, aviation, and heavy-duty trucks.

Scaling up financial flows toward mitigation and sustainability and away from fossil fuel subsidies can help achieve climate targets without overlooking environmental justice.

- Financial flows and policy coverage are uneven across regions and sectors, and remain an obstacle to mitigation. However, policy can help bring into alignment Sustainable Development Goals with mitigation.
- Challenges of deployment of mitigation strategies, including agricultural shifts, encouraging balanced and sustainably appropriate diets can be supported through nationally specific policies relying on local expertise, including Indigenous knowledge, and economy-wide sustainable development policies.

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