IPCC Working Group III Report on the Mitigation of Climate Change (2022)

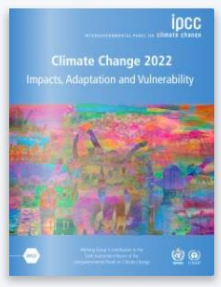
May 10, 2022

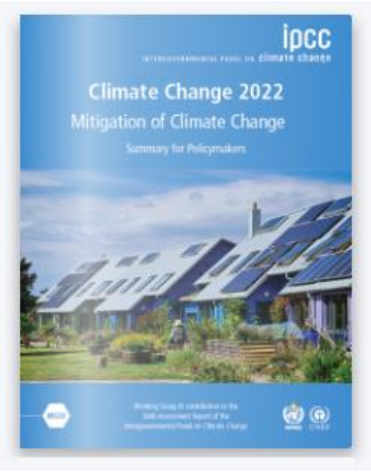
Background on IPCC

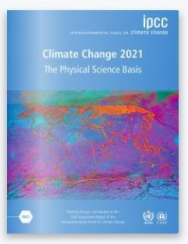
- **Intergovernmental Panel on Climate Change**
- Assembled by UN to assess the science on global climate change
  - 195 member states, hundreds of scientists
  - Intensive process of drafting and review
- Reviews provide a scientific basis for governments to develop climate-related policies
  - Doesn’t conduct its own research
  - Not policy-prescriptive
  - Characterizes degree of certainty in assessments (e.g., *high confidence*)

Background on IPCC

- **Three working groups**:
  - Working Group I: the Physical Science Basis (2021)
  - Working Group II: Impacts, Adaptation, and Vulnerability (2022)
  - Working Group II: Mitigation of Climate Change (2022)
- **Assessment Reports**
  - Full scientific, technical, and socio-economic assessment
  - Four parts: one for each working group, and then a synthesis report
  - 2022 will see the release of AR6 (AR5 was published in 2014)







Working Group I: Key Findings

- **Human-caused climate change is happening.** “It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred (WGI, SPM A.1).”
- **Climate change is causing extreme weather events.** “Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5 (WGI, SPM A.3).”

Working Group II: Key Findings

- **Not everyone is equally vulnerable to the effects of climate change.** “Vulnerability of ecosystems and people to climate change differs substantially among and within regions (*very high confidence*), driven by patterns of intersecting socio-economic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance (*high confidence)* (WGII, SPM B.2).”

Working Group II: Key Findings

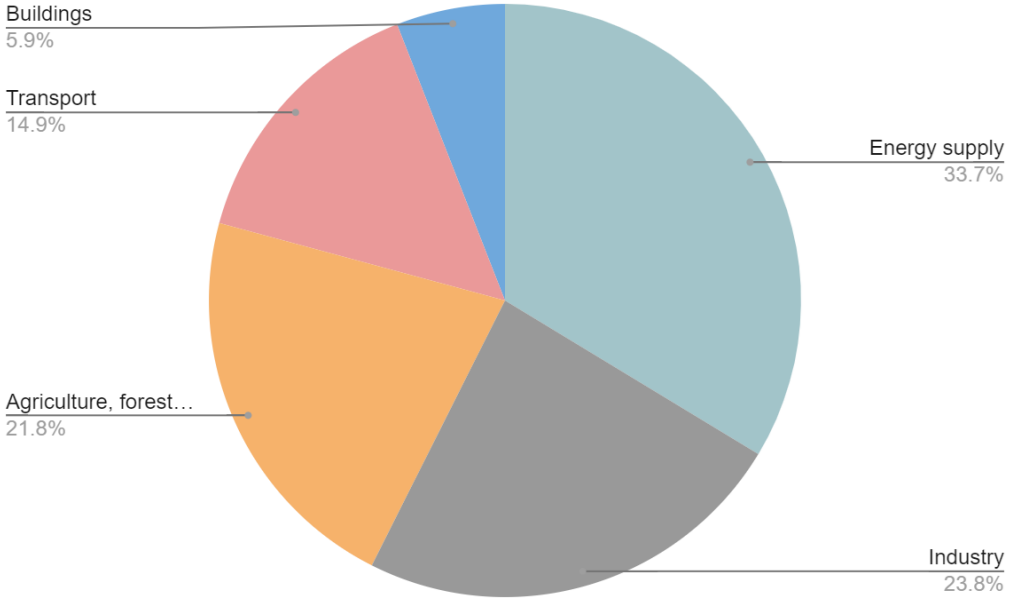
- **Even warming of 1.5°C poses serious threats.** “Global warming, reaching 1.5°C in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (*very high confidence*)… Near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems… but cannot eliminate them all (*very high confidence*) (WGII, SPM B.3).”

Working Group II: Key Findings

- **But warming above 1.5°C creates even greater risks and could set off positive feedback loops.** “If global warming transiently exceeds 1.5°C in the coming decades or later (overshoot), then many human and natural systems will face additional severe risks, compared to remaining below 1.5°C (*high confidence*). Depending on the magnitude and duration of overshoot, some impacts will cause release of additional greenhouse gases (*medium confidence*) and some will be irreversible, even if global warming is reduced (*high confidence*) (WGII, SPM B.6).”

Overview of Relevant Findings from WGIII

Emissions increased across all sectors, and urban sectors are responsible for a growing share of these emissions (62% in 2015, to 67-72% in 2020).



SPM pg. 7-8

Emissions continue to rise: Total human-caused emissions continued to rise from 2010 to 2019, although rate of growth from 2010 to 2019 (1.3% per year) was slower than that of 2000 to 2009 (2.1% per year).

Contributions to climate change have **varied regionally**.

SPM pg. 4, 11

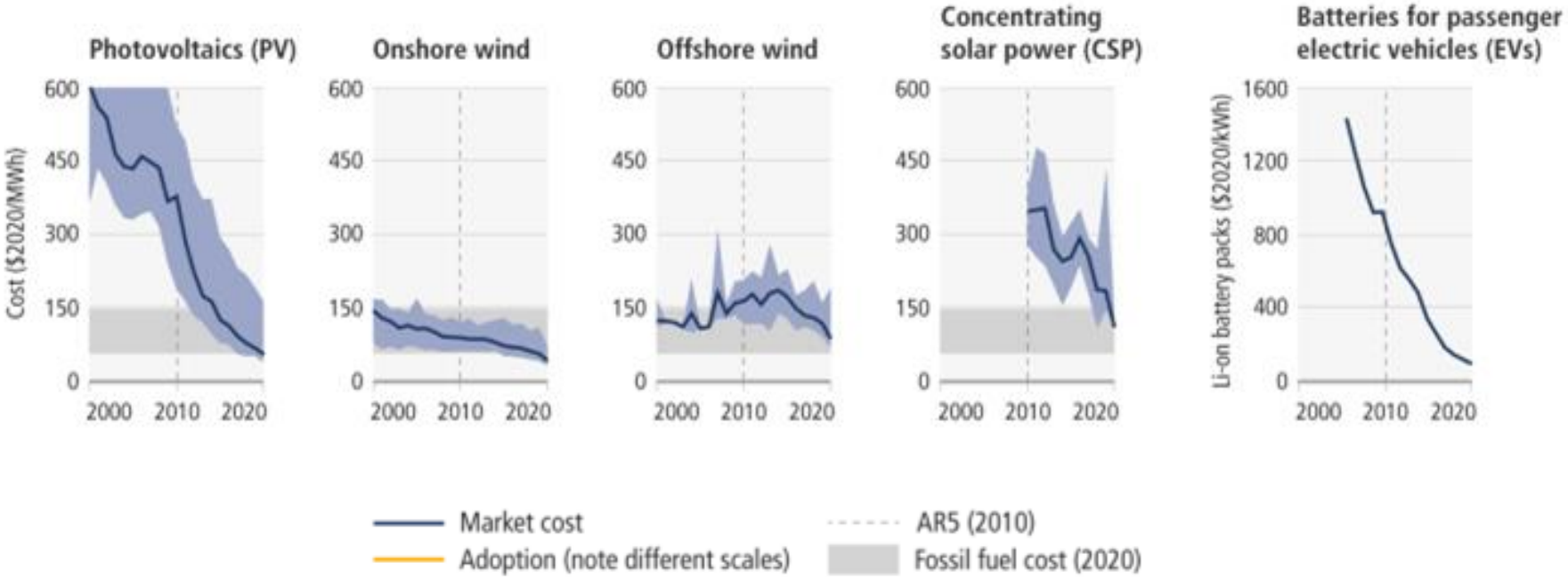
The energy transition will play a key role in mitigation: Warming cannot be limited to well below 2°C without rapid and deep reductions in energy system CO_2 and GHG emissions (WGIII, 6-3).

Costs of low-emissions technologies have **continued to fall**: from 2010 to 2019, unit cost for solar fell 85%, wind fell 55%, and lithium battery fell 85% (SPM B.4.1).

But today, **wind and solar combined only represent 10% of combined market share** (TS.5, 2.5) – by 2050, low-carbon electricity should represent 100% of market share.

SPM pg. 12-13

The unit costs of some forms of renewable energy and of batteries for passenger EVs have fallen, and their use continues to rise.



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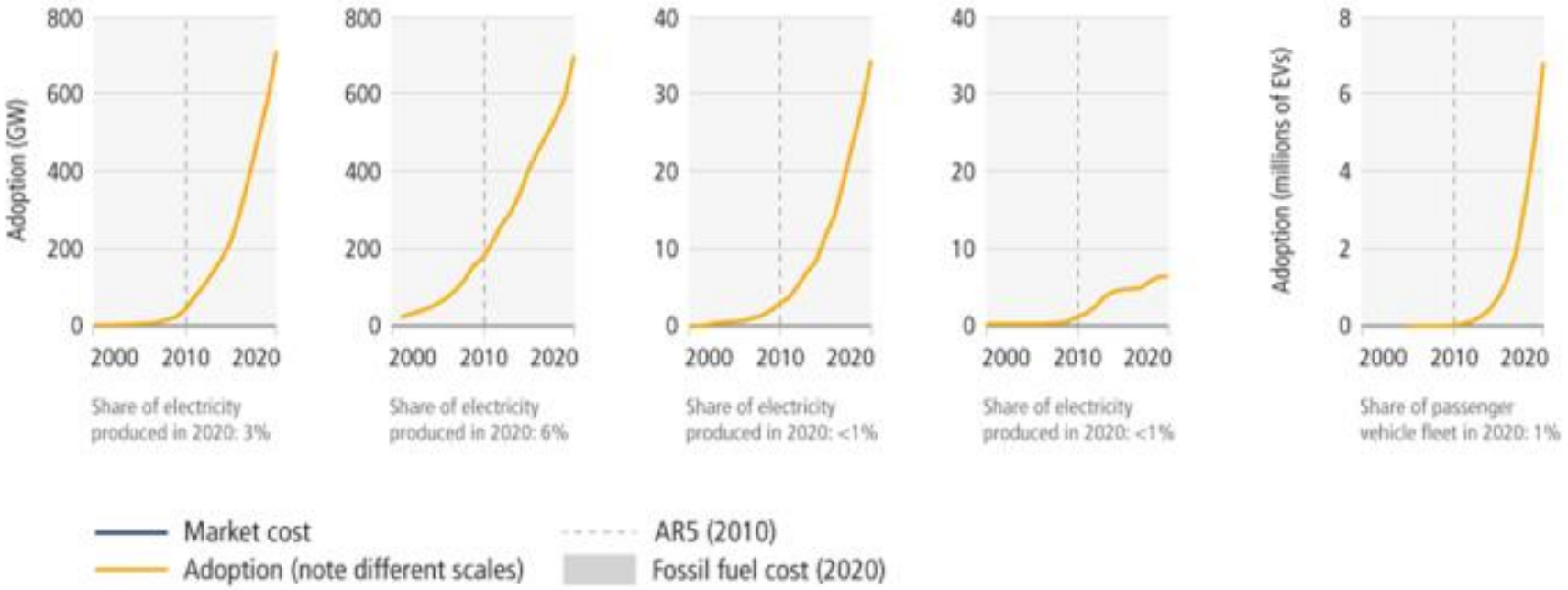


We'll also need to remove emissions: Deployment of carbon dioxide removal (CDR) to compensate for residual/hard-to-abate emissions is unavoidable (SPM C.11).

This can be done in several ways: "Biological, geochemical, and chemical processes available, at varying levels of maturity (SPM C.11.1)." "Impacts, risks, and co-benefits of CDR for ecosystems, communities, and biodiversity will depend on method, site context, and scale (*high confidence*) (SPM C.11.2)."

Forests, farms, and natural ecosystems can play a role too: The land sector (agriculture, forestry, and land-use) can deliver significant emissions reductions and removals, but can’t make up for delays in other sectors (SPM C.9).

Existing policies have already spurred mitigation, and this has already led to the avoidance of emissions that would have otherwise occurred (SPM B.5).

Pledges fall short: Current national commitments announced before COP26 make it likely that we will not be able to limit warming to 1.5°C, and would need to rapidly decarbonize to limit warming to 2°C, by 2030 (SPM B.6).

And existing policies fall even shorter: Currently, the policies in place in 2020 put us on track to fall short of those national commitments (SPM B.6.1).

No room for more unabated fossil fuel generation: Emissions from current and planned fossil fuel infrastructure (without additional abatement) are likely to result in overshoot of 1.5°C. In other words, if investments in coal and other fossil infrastructure continue, energy systems will be locked-in to higher emissions, making it harder to limit warming to well below 2°C (WGIII, 6-4).

Urban areas provide unique opportunities, via “systemic transformation” of infrastructure and urban form, by:

1. Reducing/changing material and energy consumption;
2. Electrification; and
3. Enhancing carbon uptake and storage (SPM C.6).

Thinking outside boundaries: Cities can achieve net-zero emissions, but only if emissions are reduced within and outside of their administrative boundaries through supply chains, which will have beneficial cascading effects across other sectors. (*very high confidence*) (SPM C.6).

Demand-focused interventions can reduce demand for all transport services and support the shift to more energy efficient transport modes (*medium confidence*), which includes:

1. Changes in urban form (density, land use mix);
2. Investments in inter- and intra-city public transit; and
3. Active transport infrastructure, etc. (SPM C.8).

A big opportunity, with co-benefits: “Demand-side mitigation could reduce global GHG emissions in end-use sectors by 40-70% in 2050. And at the same time, these measures could enhance human well-being (*high confidence*) (SPM C.10).”

What is demand-side mitigation?

“Electric vehicles powered by low emissions electricity offer the largest decarbonisation potential for land-based transport, on a life cycle basis (*high confidence*) (SPM C.8).”

Additional examples of demand-side mitigation include co-location of jobs and housing, efficient building floor plans, reallocation of street space, switching to sustainable and healthy diets, food waste reduction, and use of longer-lived, repairable products.

Current funding falls short: Investment in climate change mitigation and adaptation falls far short of what is necessary (SPM E.5).

- Overwhelmingly on **mitigation** (90%).
- **Energy efficiency** investments must increase 2-7x.
- **Transport** investments must increase 7-8x.
- **Electricity** investments must increase by 2-5x.
- **Land sector** investments must increase by 10-29x.

Technical Summary, pg. 124-125

Social/Demand-Side Measures

Individual choices can add up: “Socio-cultural and lifestyle changes can accelerate climate change mitigation (*medium confidence*). Of these, individual mobility choices have the greatest potential: walking, cycling, and EVs could save 2 tons of CO_2e per person per year (WGIII, 5-3).”

But the larger social, political, & cultural context sets the stage:

- “Demand-side solutions require both motivation and capacity for change (*high confidence*).”
- “Transition pathways and changes in social norms often start with pilot experiments led by dedicated individuals and niche groups (*high confidence)* (WGIII, 5-4 and 5-5).”
- “Social equity reinforces capacity and motivation for mitigating climate change (*medium confidence*) (WGIII, 5-6).”
- “Changes in consumption choices that are supported by structural changes and political action enable the uptake of low-carbon choices (*high confidence*) (WGIII, 5-6).”
- “Mitigation policies that integrate and communicate with the values people hold are more successful (*high confidence*) (WGIII, 5-6).”

Energy Systems

“**Multiple energy supply options are available** to reduce emissions over the next decade (*high confidence*)” (WGIII, 6-4). But it won’t be possible to deploy them widely without an **enabling environment** (economic, technological, institutional, environmental-ecological, socio-cultural) and better integration.

A low-carbon energy transition will **shift investment patterns and create new economic opportunities** (WGIII, 6-4).

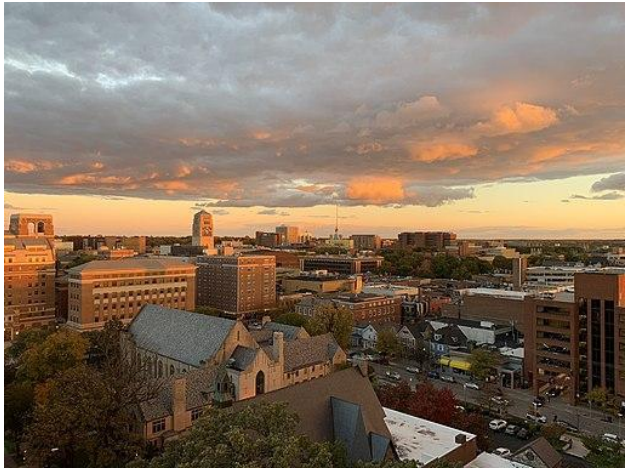
The **economic outcomes** of low-carbon transitions in some sectors and regions may be **on par with, or superior to** those of an emissions-intensive future (WGIII, 6-5).

“Climate change will affect many future local and national low-carbon energy systems. The impacts, however, are uncertain, particularly at the regional scale (*high confidence*) (WGIII, 6-4).”

Climate change will alter hydropower production, bioenergy and agricultural yields, thermal power plant efficiencies, and demands for heating and cooling, and it will directly impact power system infrastructure. Climate change will not affect wind and solar resources to the extent that it would compromise their ability to reduce emissions (*high confidence*) (WGIII, 6-4).

Urban Areas

“**Urban land areas could triple between 2015 and 2050, with significant implications for carbon lock-in.** The construction of new, and upgrading of, existing urban infrastructure through 2030 will result in significant emissions (*very high confidence*) (WGIII, 8-5).”



“Given the dual challenges of rising urban GHG emissions and projections of more frequent extreme climate events, there is **an urgent need to integrate urban mitigation and adaptation strategies** to address climate change and withstand its effects (*very high confidence*) (WGIII, 8-5).”

“Integrated spatial planning to achieve **compact and resource-efficient urban growth** through co-location of higher residential and job densities, mixed land use, and transit-oriented development could reduce GHG emissions between 23-26% by 2050 compared to the business-as-usual scenario (*robust evidence, high agreement, very high confidence*) (WGIII, 8-6).”

“As a reaffirmation of AR5, **population density reduces emissions per capita in the transport, building, and energy sectors**... Urban compactness tends to reduce emissions per capita in the transport sector, especially for community (WGIII, 8-56).” But **socioeconomic status and lifestyle preferences affect this, too**.

Our green spaces can reduce our energy demand: Urban green and blue infrastructure can mitigate climate change through carbon sequestration, avoided emissions, and reduced energy use while offering multiple co-benefits (*robust evidence, high agreement*) (WGIII, 8-6).

“Green infrastructure and “blue infrastructure,” including urban forests and street trees, permeable surfaces, and green roofs, which can all **contribute to a cooling effect that reduces direct energy demand and energy use for water treatment** (WGIII, 8-6).

Questions?

References:

Working Group I: Summary for Policymakers (2021)
Working Group II: Summary for Policymakers (2022)
Working Group III: Summary for Policymakers (2022)
Working Group III: Full Report (2022)
IPCC Fact Sheet

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