Key Messages

- Human influence on the climate system is clear.

- The more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts.

- We have the means to limit climate change and build a more prosperous, sustainable future.
Humans are changing the climate

It is extremely likely that we are the dominant cause of warming since the mid-20th century.

Globally averaged combined land and ocean surface temperatures

Decadal average
Globally averaged combined land and ocean surface temperature anomaly

1850 1900 1950 2000

Year

°C
(a) Globally averaged combined land and ocean surface temperature anomaly

(b) Globally averaged sea level change
Oceans absorb most of the heat

Energy accumulation within the Earth’s climate system

More than 90% of the energy accumulating in the climate system between 1971 and 2010 has accumulated in the ocean.

Land temperatures remain at historic highs while ocean temperatures continue to climb.
GHG emissions growth has accelerated despite reduction efforts

Based on Figure 1.3
AFOLU second largest emitting sector - 20-24% of total emissions
Emissions decreased in last decade
Projected global average surface temperature change

Mean over 2081–2100

Historical
RCP2.6
RCP8.5

RCP4.5
RCP6.0
RCP8.5

IPCC 2013
The Choices We Make Will Create Different Outcomes

With substantial mitigation

Without additional mitigation

Change in average surface temperature (1986–2005 to 2081–2100)
Locations of substantial drought- and heat-induced tree mortality around the globe since 1970
Forest Fire Risk

(a) Baseline climate (1961–1990)

(b) climate scenario 2041–2070 (A1B emission scenario)
Species displacement rate

(a) Rates of climate change
(b) corresponding climate velocities
(c) rates of displacement in the absence of human intervention.
Key risks from climate change and the potential for reducing risk through mitigation and adaptation.

<table>
<thead>
<tr>
<th>Key risk</th>
<th>Adaptation issues &amp; prospects</th>
<th>Climatic drivers</th>
<th>Timeframe</th>
<th>Risk &amp; potential for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduction in terrestrial carbon sink</strong>: Carbon stored in terrestrial ecosystems is vulnerable to loss back into the atmosphere. Key mechanisms include an increase in fire frequency due to climate change and the sensitivity of ecosystem respiration to rising temperatures. <em>(medium confidence)</em></td>
<td>Adaptation prospects include managing land use (including deforestation), fire, and other disturbances and non-climatic stressors.</td>
<td><img src="Image" alt="Sun" /></td>
<td>Present</td>
<td>Very low</td>
</tr>
<tr>
<td><strong>Boreal tipping point</strong>: Arctic ecosystems are vulnerable to abrupt change related to the thawing of permafrost and spread of shrubs in tundra and increase in pests and fires in boreal forests. <em>(medium confidence)</em></td>
<td>There are few adaptation options in the Arctic.</td>
<td><img src="Image" alt="Sun" /></td>
<td>Near term (2030 – 2040)</td>
<td>Very high</td>
</tr>
<tr>
<td><strong>Amazon tipping point</strong>: Moist Amazon forests could change abruptly to less carbon-dense drought and fire-adapted ecosystems. <em>(low confidence)</em></td>
<td>Policy and market measures to reduce deforestation and fire.</td>
<td><img src="Image" alt="Sun" /></td>
<td>Long term 2°C (2080–2100)</td>
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<td><img src="Image" alt="Sun" /></td>
<td>Long term 4°C (2080–2100)</td>
<td>Very high</td>
</tr>
</tbody>
</table>

[4.2.4, 4.3.2, 4.3.3]

[4.3.3.1.1, Box 4-4]

[4.3.3.1.3, Box 4-3]
Temperature increase and cumulative carbon emissions
Temperature increase and cumulative carbon emissions
The window for action is rapidly closing

65% of our carbon budget compatible with a 2°C goal already used

**Total Carbon Budget:**
- **790 GtC**

**Amount Used 1870-2011:**
- **515 GtC**

**Amount Remaining:**
- **275 GtC**
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.

Based on Figure 6.7

IPCC AR5 Synthesis Report
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.

Based on Figure 6.7
Figure SPM.10: A reader’s guide

From climate change risks to GHG emissions

(A) Risks from climate change...

(B) ...depend on cumulative CO₂ emissions...

(C) ...which in turn depend on annual GHG emissions over the next decades
Mitigation Measures

More efficient use of energy

Greater use of low-carbon and no-carbon energy
- Many of these technologies exist today

Improved carbon sinks
- Reduced deforestation and improved forest management and planting of new forests
- Bio-energy with carbon capture and storage

Lifestyle and behavioural changes
AFOLU Economic mitigation potential in 2030 by region

**Supply side**: economic potential 7.18-10.6 GtCO$_2$e/y at carbon prices up to 100 USD/tCO$_2$e. About one third at <20 USD/tCO$_2$e
Regional differences in forestry options, shown as a proportion of total potential available in forestry.
Global technical Bioenergy potential for 2050
Regional land cover change by 2030 from 2005

Results from three models for baseline, and idealized policy implementation scenarios for 550 ppm CO$_2$ eq and 450 ppm CO$_2$ eq

Legend:
- Abandoned
- Energy crops
- Non-energy crops
- Forest
- Other arable
- Other
- Pasture
Summary – Role of AFOLU in climate change mitigation

• Net annual baseline CO2 emissions projected to decline
• Could contribute 20-60% to mitigation in 2030; 15-40% in 2100
• Economic mitigation potential of supply-side options estimated to be 7.18-10.60 GtCO2eq/yr
• AR5 transformation pathways suggest 5-95 EJ/yr primary energy from bioenergy in 2030 and 10-245 EJ/yr by 2050. Some models assume 35% in 2050 and up to 50% in 2100.
• BECCS features prominently in many mitigation scenarios

BUT
• If terrestrial land carbon stock remains unprotected large GHG emissions from negative supply-side LUC possible.
Delaying mitigation increases the difficulty and narrows the options for limiting warming to 2°C.

„immediate action“
Delivering mitigation increases the difficulty and narrows the options for limiting warming to 2°C.
Delaying mitigation increases the difficulty and narrows the options for limiting warming to 2°C.
Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.

„delayed mitigation“

„immediate action“
Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.
Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.

Based on Figures 6.32 and 7.16
Availability of technology can greatly influence mitigation costs.

Based on Figure 6.24
Ambitious Mitigation Is Affordable

- Economic growth reduced by ~0.06% (BAU growth 1.6 - 3%)
- This translates into delayed and not forgone growth
- Estimated cost does not account for the benefits of reduced climate change
- Unmitigated climate change would create increasing risks to economic growth