IPCC Special Reports and Work in Progress

Relevance for ETP-2020



ETP-2020: Accelerating Clean Energy Technology Innovation
IEA Workshop

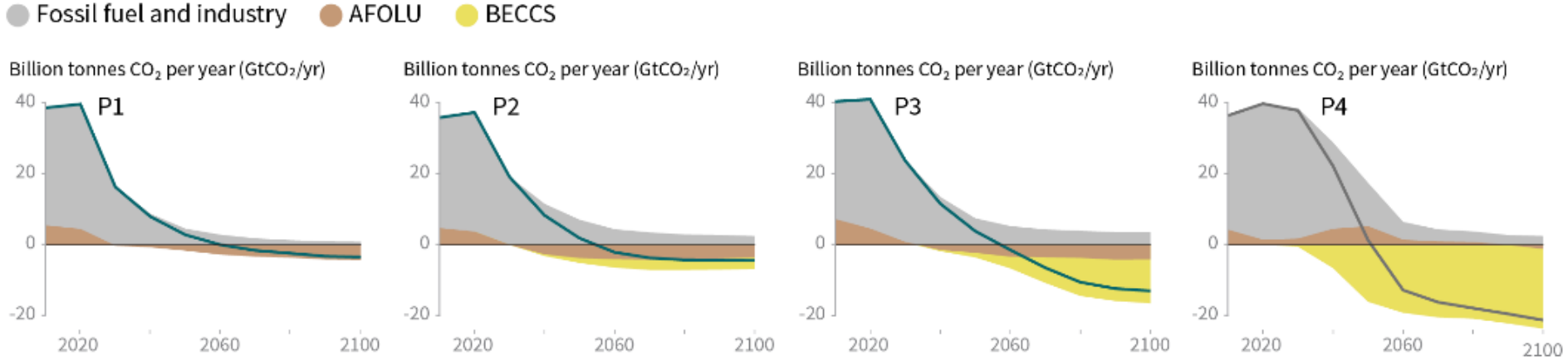
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WG III IPCC

IPCC SR15

"Rapid, far-reaching and unprecedented changes in all systems"

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

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INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security

Panel A shows response options that can be implemented without or with limited competition for land, including some that have the potential to reduce the demand for land. Co-benefits and adverse side effects are shown quantitatively based on the high end of the range of potentials assessed. Magnitudes of contributions are categorised using thresholds for positive or negative impacts. Letters within the cells indicate confidence in the magnitude of the impact relative to the thresholds used (see legend). Confidence in the direction of change is generally higher.

	Response options based on land management	Mitigation	Adaptation	Desertification	Land Degradation	Food Security	Cost
Agriculture	Increased food productivity	L	M	L	M	H	—
	Agro-forestry	M	M	M	M	L	●
	Improved cropland management	M	L	L	L	L	●●
	Improved livestock management	M	L	L	L	L	●●●
	Agricultural diversification	L	L	L	M	L	●
	Improved grazing land management	M	L	L	L	L	—
	Integrated water management	L	L	L	L	L	●●
	Reduced grassland conversion to cropland	L	—	L	L	- L	●
Forests	Forest management	M	L	L	L	L	●●
	Reduced deforestation and forest degradation	H	L	L	L	L	●●
Soils	Increased soil organic carbon content	H	L	M	M	L	●●
	Reduced soil erosion	⟷ L	L	M	M	L	●●
	Reduced soil salinization	—	L	L	L	L	●●
	Reduced soil compaction	—	L	—	L	L	●
Other ecosystems	Fire management	M	M	M	M	L	●
	Reduced landslides and natural hazards	L	L	L	L	L	—
	Reduced pollution including acidification	⟷ M	M	L	L	L	—
	Restoration & reduced conversion of coastal wetlands	M	L	M	M	⟷ L	—
	Restoration & reduced conversion of peatlands	M	—	na	M	- L	●
	Response options based on value chain management						
Demand	Reduced post-harvest losses	H	M	L	L	H	—
	Dietary change	H	—	L	H	H	—
	Reduced food waste (consumer or retailer)	H	—	L	M	M	—
Supply	Sustainable sourcing	—	L	—	L	L	—
	Improved food processing and retailing	L	L	—	—	L	—
	Improved energy use in food systems	L	L	—	—	L	—
	Response options based on risk management						
Risk	Livelihood diversification	—	L	—	L	L	—
	Management of urban sprawl	—	L	L	M	L	—
	Risk sharing instruments	⟷ L	L	—	⟷ L	L	●●

Options shown are those for which data are available to assess global potential for three or more land challenges.
The magnitudes are assessed independently for each option and are not additive.

Key for criteria used to define magnitude of impact of each integrated response option

		Mitigation *Gt CO_2-eq yr^{-1}*	Adaptation *Million people*	Desertification *Million km^2*	Land Degradation *Million km^2*	Food Security *Million people*
Positive	Large	More than 3	Positive for more than 25	Positive for more than 3	Positive for more than 3	Positive for more than 100
	Moderate	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
	Small	Less than 0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
	Negligible	No effect	No effect	No effect	No effect	No effect
Negative	Small	Less than -0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
	Moderate	-0.3 to -3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
	Large	More than -3	Negative for more than 25	Negative for more than 3	Negative for more than 3	Negative for more than 100

⟷ **Variable:** Can be positive or negative — no data — na not applicable

Confidence level
Indicates confidence in the estimate of magnitude category.
- H *High confidence*
- M *Medium confidence*
- L *Low confidence*

Cost range
See technical caption for cost ranges in US$ tCO_2e^{-1} or US$ ha^{-1}.
- ●●● High cost
- ●● Medium cost
- ● Low cost
- — no data

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We looked at **28** different response options that can be implemented with **limited or no competition** for land.

Almost all response options have a **positive effect** on **mitigation, adaptation, desertification, land degradation** and **food security**.

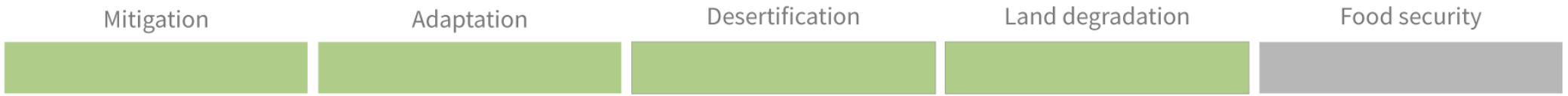
IPCC SRCCL

When implemented using best-practice, the response option almost always has a positive impact on land challenges.

Bioenergy and BECCS



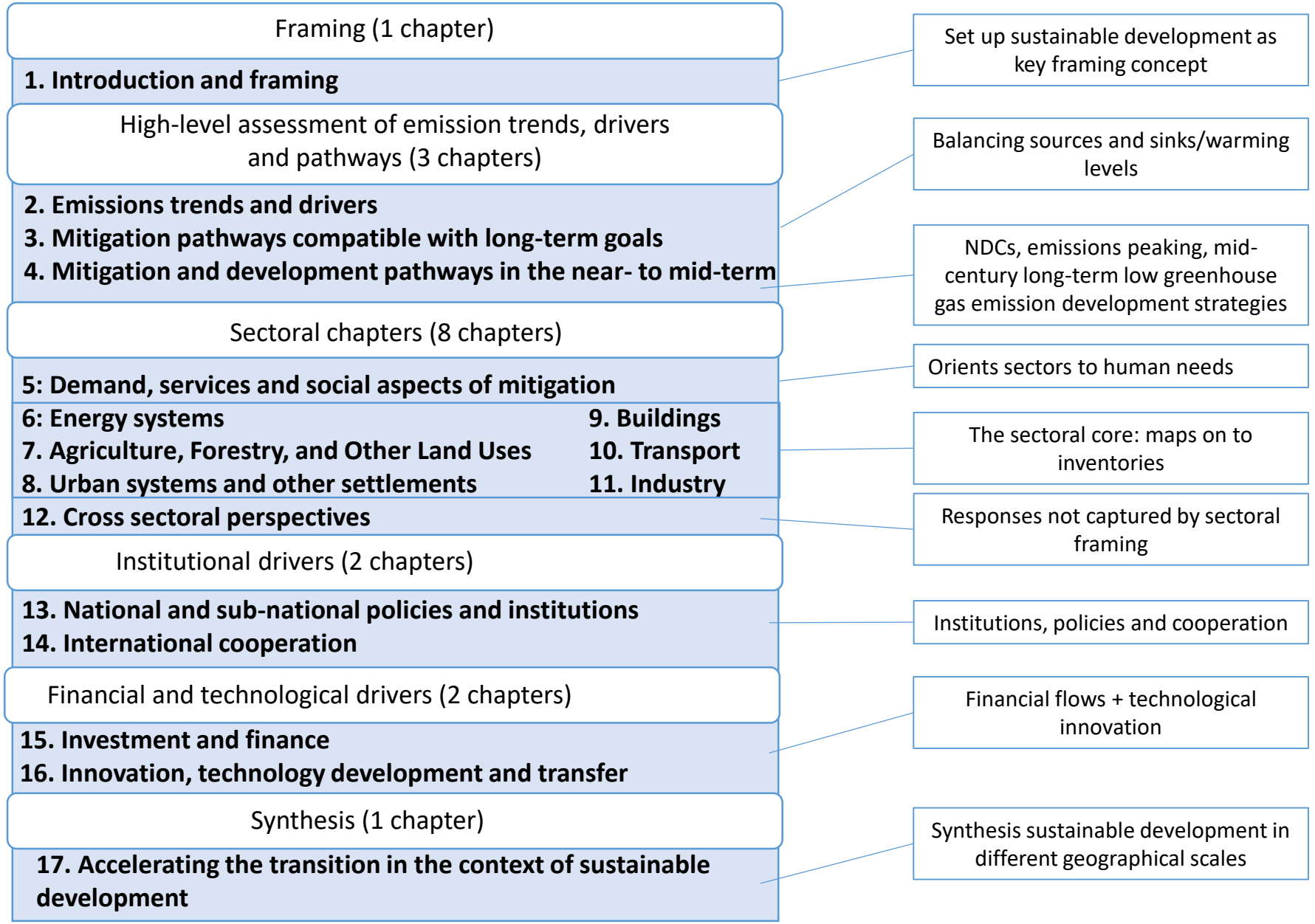
High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts, assuming carbon dioxide removal by BECCS at a scale of 11.3 $GtCO_2$ yr^{-1} in 2050, and noting that bioenergy without CCS can also achieve emissions reductions of up to several $GtCO_2$ yr^{-1} when it is a low carbon energy source {2.7.1.5; 6.4.1.1.5}. Studies linking bioenergy to food security estimate an increase in the population at risk of hunger to up to 150 million people at this level of implementation {6.4.5.1.5}. The red hatched cells for desertification and land degradation indicate that while up to 15 million km_2 of additional land is required in 2100 in 2°C scenarios which will increase pressure for desertification and land degradation, the actual area affected by this additional pressure is not easily quantified {6.4.3.1.5; 6.4.4.1.5}.



Best practice: The sign and magnitude of the effects of bioenergy and BECCS depends on the scale of deployment, the type of bioenergy feedstock, which other response options are included, and where bioenergy is grown (including prior land use and indirect land use change emissions). For example, limiting bioenergy production to marginal lands or abandoned cropland would have negligible effects on biodiversity, food security, and potentially co-benefits for land degradation; however, the benefits for mitigation could also be smaller. {Table 6.58}

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INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Approved outline of WG III AR6



Approved outline of WG III AR6

Framing (1 chapter)

1. Introduction and framing

High-level assessment of emission trends, drivers and pathways (3 chapters)

2. Emissions trends and drivers
3. Mitigation pathways compatible with long-term goals
4. Mitigation and development pathways in the near- to mid-term

Sectoral chapters (8 chapters)

5: Demand, services and social aspects of mitigation

6: Energy systems
7. Agriculture, Forestry, and Other Land Uses
8. Urban systems and other settlements
9. Buildings
10. Transport
11. Industry

12. Cross sectoral perspectives

Institutional drivers (2 chapters)

13. National and sub-national policies and institutions
14. International cooperation

Financial and technological drivers (2 chapters)

15. Investment and finance
16. Innovation, technology development and transfer

Synthesis (1 chapter)

17. Accelerating the transition in the context of sustainable development

Plus: Annex on scenarios and modelling methodology

WMO UNEP

Chapter 2: Emissions trends and drivers

- Past and present trends of territorial emissions and sinks on an annual and cumulative basis (by region, sector, GHG, etc.), including estimates of uncertainty
- Past and present trends of consumption-based emissions on an annual and cumulative basis (by region, sector, GHG, etc.), including estimates of uncertainty
- Socio-economic and demographic drivers (e.g. GDP, population, international trade) and their trends
- Overview of sectoral emission drivers and their trends
- Climate and non-climate policies and measures at different scales and their impacts on emissions
- Technological choices and changes and impacts of technological breakthroughs
- Emissions associated with existing and planned long-lived infrastructure
- Behavioural choices and lifestyles at individual and societal levels

Chapter 3: Mitigation pathways compatible with long-term goals

- Methods of assessment, including approaches to analysis of mitigation and development pathways
- Socio-cultural-techno-economic assumptions and projections, including regional differences (referring to baseline and mitigation scenarios, Shared Socio-economic Pathways (SSPs), etc.
- Modelled emission pathways compatible with the Paris Agreement, including the long-term temperature goal, and higher warming levels, taking into account CO_2, non-CO_2 and short-lived climate forcers (including peaking, rates of change, balancing sources and sinks, and cumulative emissions)
- Role of changing climate on emissions
- System transitions and/or transformation compatible with mitigation pathways, including supply and demand and integrating sectoral information
- Economics of mitigation and development pathways, including mitigation costs, investment needs, employment effects, etc.
- Technological and behavioural aspects of mitigation pathways and socio-technical transitions
- Interaction between near- to mid-term action, and long-term mitigation pathways
- Links to sustainable development including risks, co-benefits, synergies, trade-offs and spill-over effects
- Links to adaptation including risks, co-benefits, synergies, trade-offs and spill-over effects
- Benefits of mitigation, including information from WG II
- Risk analysis of emission pathways considering uncertainty about climate response

Chapter 6: Energy systems

- Energy services, energy systems and energy sector, integrations with other systems (including food supply system, buildings, transportation, industrial systems)
- Energy resources (fossil and non-fossil) and their regional distribution
- Global and regional new trends and drivers
- Policies and measures and other regulatory frameworks; and supply and demand systems
- Fugitive emissions and non-CO_2 emissions
- Global and regional new trends for electricity and low carbon energy supply systems, including deployment and cost aspects.
- Smart energy systems, decentralized systems and the integration of the supply and demand
- Energy efficiency technologies and measures
- Mitigation options (including CCS), practices and behavioural aspects (including public perception and social acceptance)
- Interconnection, storage, infrastructure and lock-in
- The role of energy systems in long-term mitigation pathways
- Bridging long-term targets with short and mid-term policies
- Sectoral policies and goals (including feed-in tariffs, renewables obligations and others)
- Mainstreaming climate into energy policy

Chapter 12: Cross sectoral perspectives

- Scope of the chapter
- Summary of sectoral costs and potentials
- Comparison of sectoral costs and potentials with integrated assessments
- Summary of sectoral co-benefits and trade-offs
- Aspects of GHG removal techniques not covered in chapters 6 to 11 (land based, ocean based, direct air capture): status, costs, potentials, governance, risks and impacts, co-benefits, trade-offs and spill-over effects, and their role within mitigation pathways
- Impacts, risks and opportunities from large-scale land-based mitigation: land, water, food security; use of shared resources; management and governance
- Emissions intensity of food systems and mitigation opportunities across the food system (production, supply chain, demand and consumption) including emerging food technologies
- Policies related to food system and food security including food waste and food demand
- Links to adaptation and sustainable development (including co-benefits, synergies and trade-offs)

Chapter 16: Innovation, technology development and transfer

- Key findings from AR5 and recent developments
- Role of innovation, technology development, diffusion and transfer in contributing to sustainable development and the aims of the Paris Agreement, including mitigation pathways
- Innovation and technology as systemic issues, evaluating literature on cases of technological innovation systems and innovation policy
- Assessment of international institutions partnerships and cooperative approaches relevant to technology, innovation and R&D
- Capacity for transformative change, including capabilities for innovation, engineering, governance, R&D cooperation and deployment incentives
- Assessment of experiences with accelerating technological change through innovation policy for climate change at the national level, including successful case studies
- Specific challenges in emerging economies and least-developed countries, e.g. SIDS and land-locked countries
- Acceptability and social inclusion in decision-making, communication and information diffusion
- Characterisation and implications of new disruptive technologies
- Links to adaptation and sustainable development (including co-benefits, synergies and trade-offs)

Chapter 15: Investment and finance

- Key findings from AR5 and recent developments
- Definitions of climate finance
- Scenarios of and needs for investment and financial flows related to mitigation pathways and climate change action at the global and regional scales
- Scenarios of and needs for investment and financial flows related to mitigation pathways and climate change action in developing countries
- Investment patterns, and financing for climate resilient development, consistent with different mitigation pathways
- Enabling conditions for changing finance and investment patterns
- Public climate finance flows, including multilateral and bilateral, taking into account the scaling up of such flows
- International private flows of climate finance
- Links between national and international finance including developments in financial mechanisms and public-private partnerships
- National and sub-national climate finance mobilization and flows, within and across countries, including links to climate policy
- Emerging trends (community involvement in climate finance, sustainable investment criteria by institutional investors)
- Climate-related investment opportunities and risks
- Linkages between finance and investments in adaptation and mitigation, and implications for sustainable development
- Case studies

Cross-cutting challenges relevant to ETP-2020

Integrated assessment modelling

- What counts as transparency
- Realistic input assumptions, endogenous change – renewables costs etc
- Intertemporal discounting
- Trade-offs involving key mitigation options – social acceptability/food security/ biodiversity and ecosystem services
- Incomplete treatment of “nature-based solutions”

Feasibility of climate ambition at the system level

- Geophysical
- Environmental
- ***Technical***
- ***Economic***
- Socio-political
- Institutional

Non-GHG metrics?

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