Climate Change 2014: Mitigation of Climate Change

Leon Clarke

U.S. DEPARTMENT OF ENERGY | Office of Science

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UNIVERSITY OF MARYLAND

Where are emissions, concentrations, and temperature currently headed?

GHG emissions have continued to rise despite reduction efforts.

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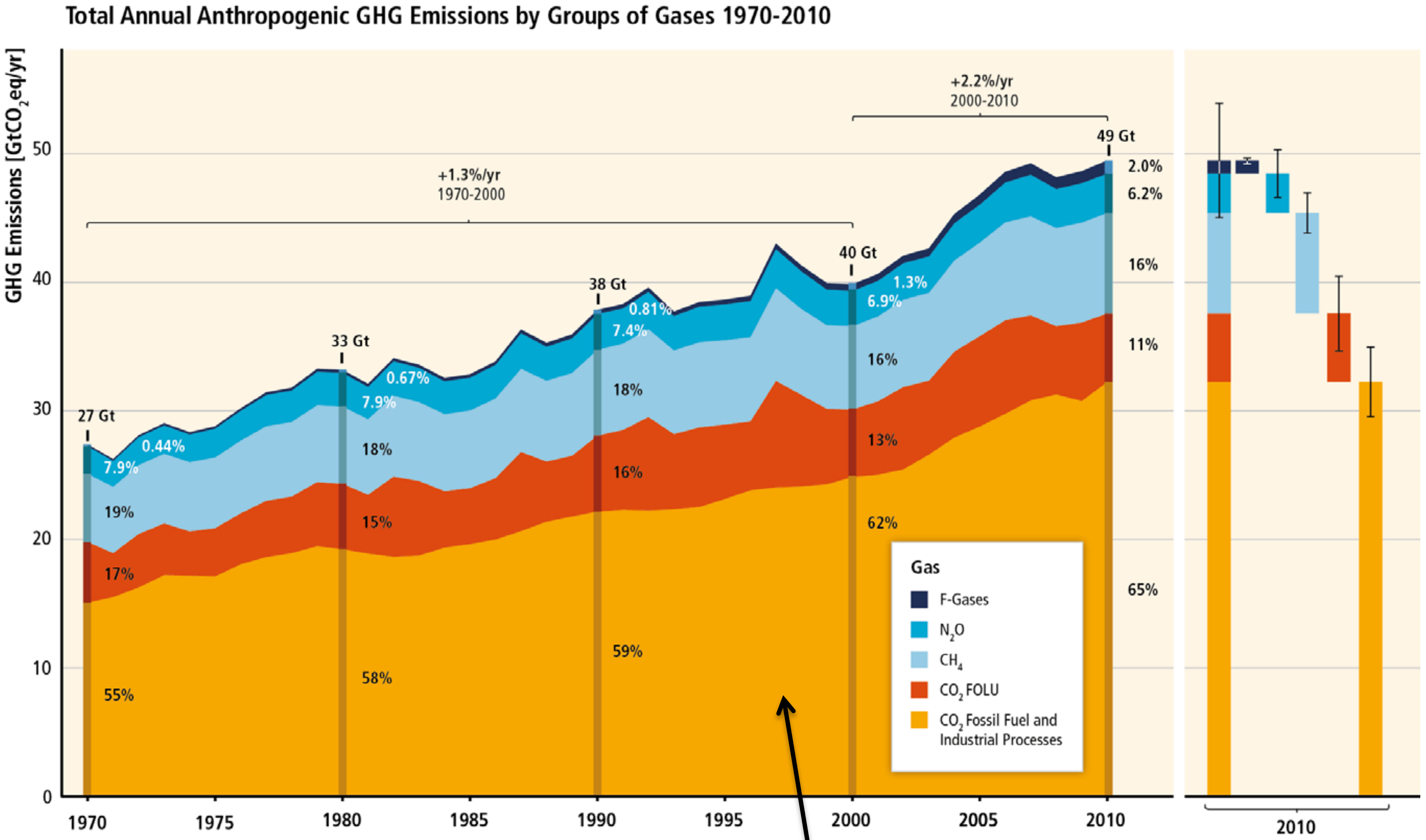
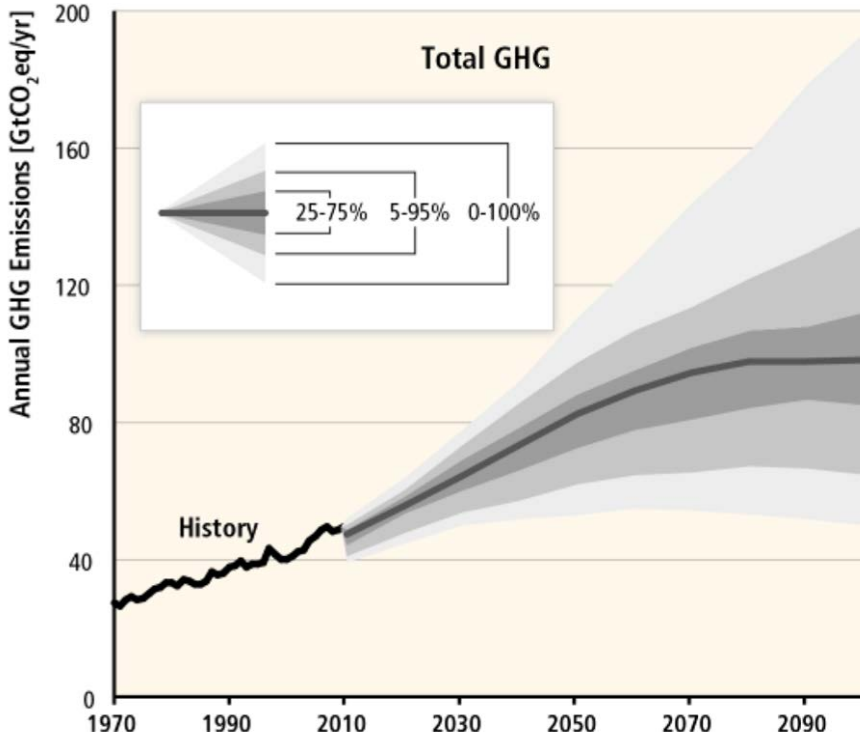


The majority of growth has come from fossil and industrial sources

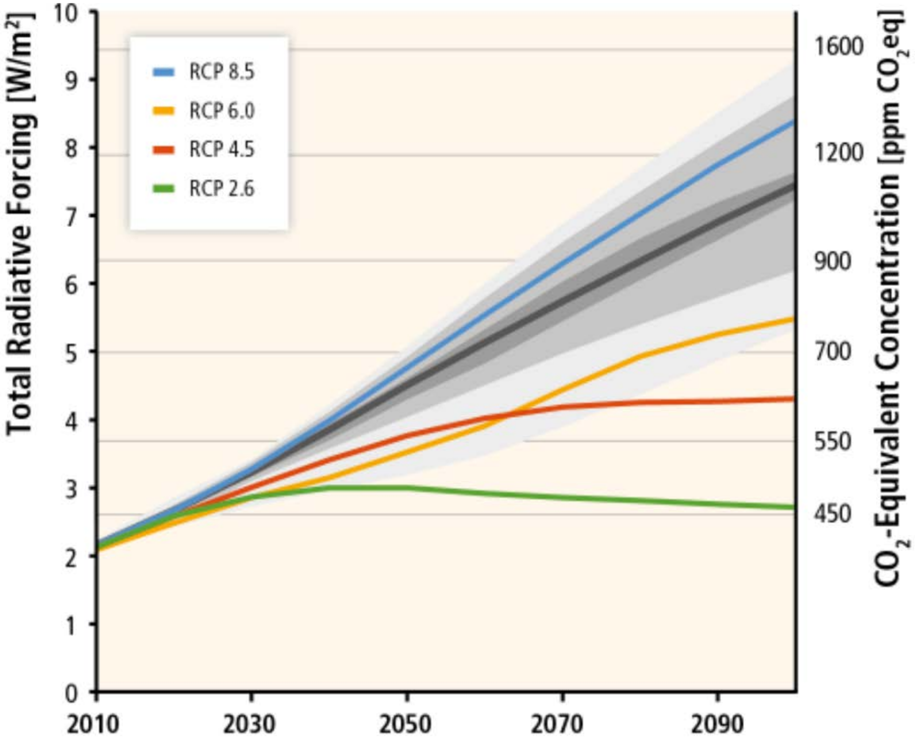
Emissions are expected to rise despite improvements in technology.

Baseline scenarios result in global mean surface temperature increases in 2100 from 3.7 to 4.8°C compared to pre-industrial levels (median values; the range is 2.5°C to 7.8°C when including climate uncertainty)

Global GHG Emissions



Global GHG Concentrations



Which emissions pathways maintain temperature change below different levels?

AR5 has collected roughly 900 mitigation scenarios leading to different 2100 concentration levels.

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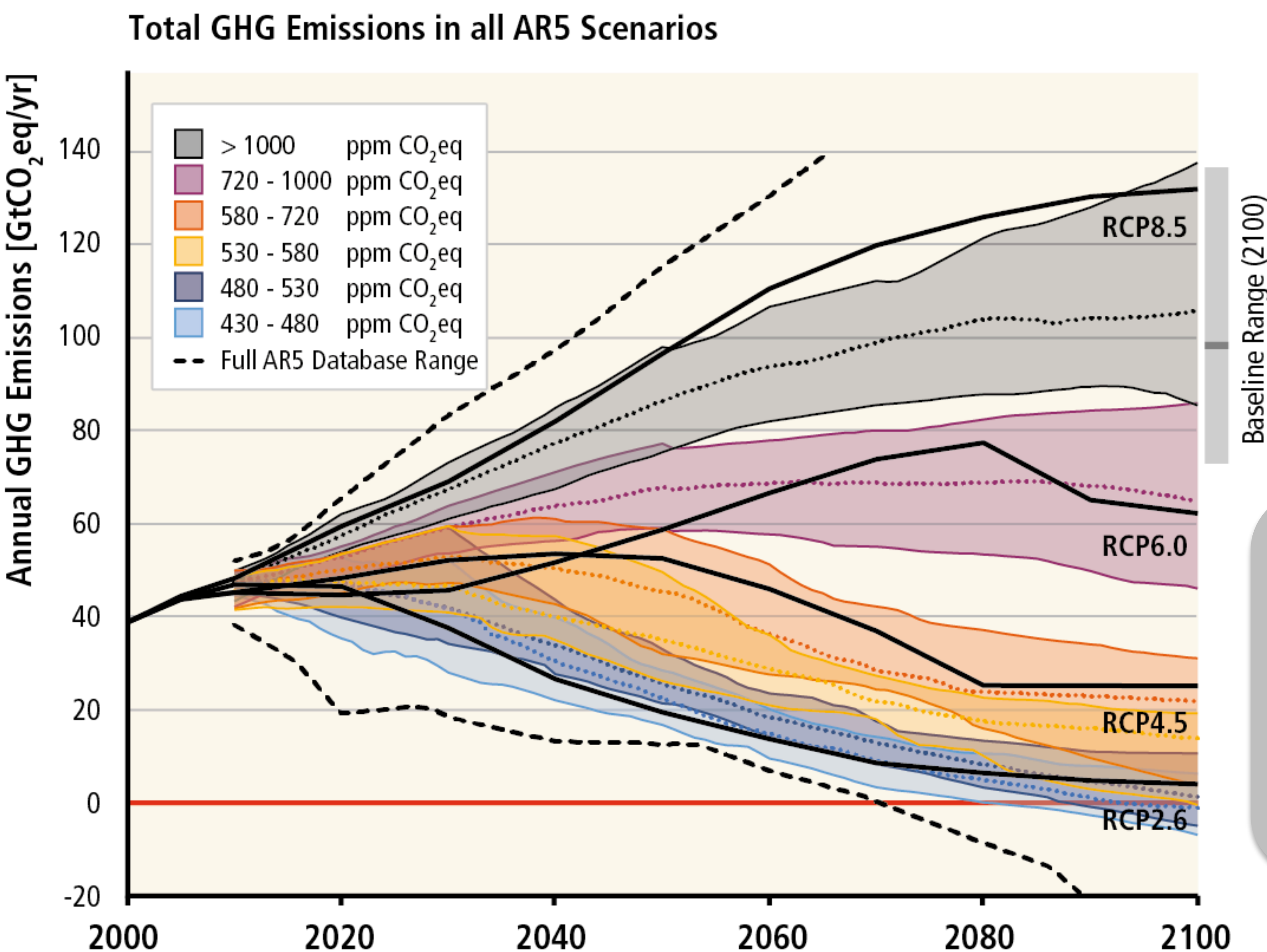

The scenarios were binned to roughly match the Representative Concentration Pathways (RCPs)

Temperature implications are ambiguous because of climate uncertainty and different definitions temperature goals.

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Category label (concentration range)[9]</th><th rowspan="3">Subcategories</th><th rowspan="3">Relative position of the RCPs[5]</th><th colspan="2">Change in CO_2eq emissions compared to 2010 in (%)[4]</th><th colspan="5">Temperature change (relative to 1850–1900)[5,6]</th></tr>
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(2) temperature in at a point in time (e.g. 2100)….

or, (3) likelihood of remaining below a particular level.

Temperature goals can be expressed in terms of (1) long-term equilibrium temperature….

450 ppmv CO2e scenarios are still loosely associated with a 2°C goal

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Emissions are substantially negative in many by 2100.

Roughly 40% to 70% reductions below 2010 levels by 2050.

The 450 ppmv CO2e scenarios are typically more unlikely then likely to remain below 1.5°C this century.

Other goals require less aggressive action in the near- and long-term, but lead to higher temperatures

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Because of the linkage of 450 ppmv CO2e to the 2°C goal, it is a major focus of WG3

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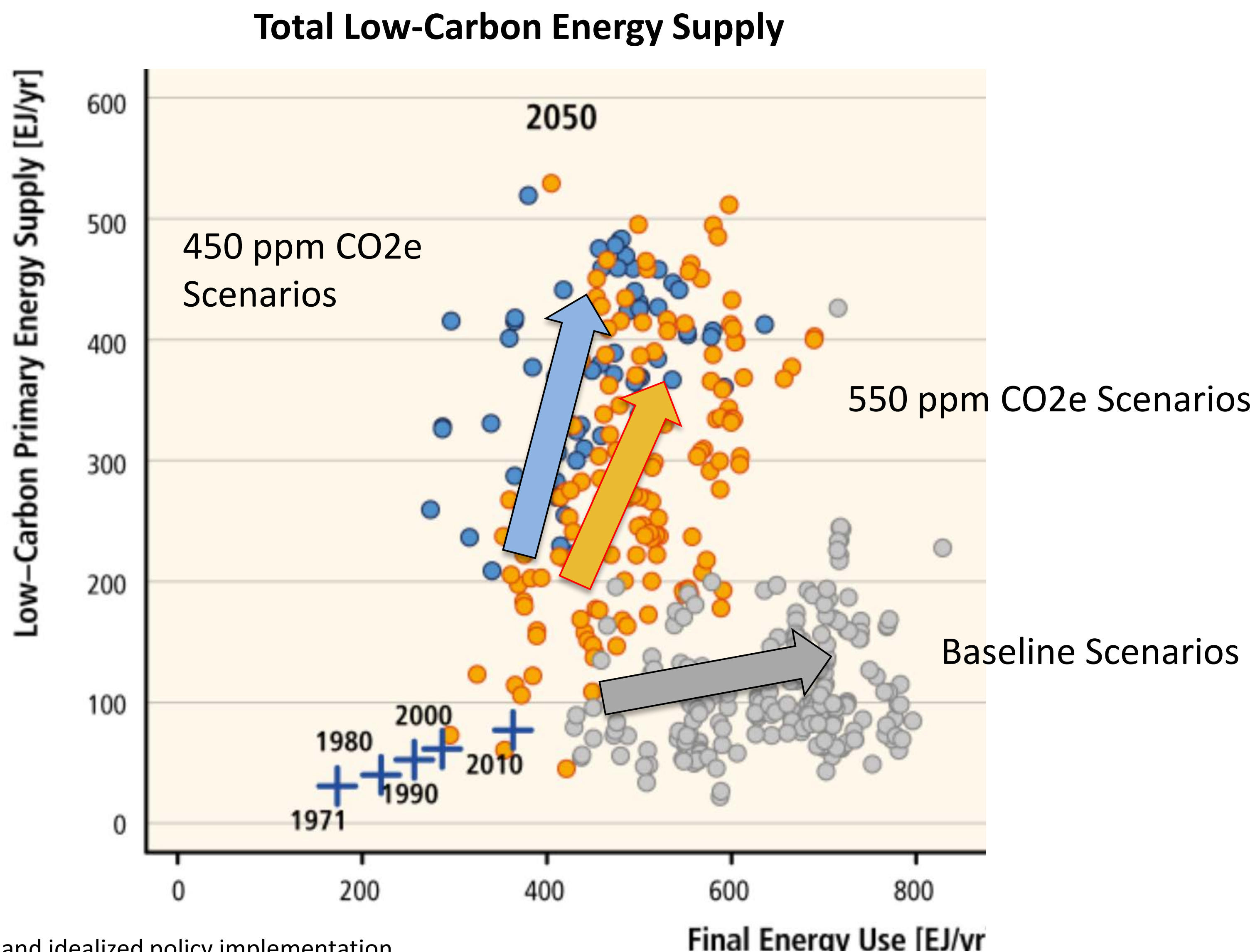
What is required to meet different concentration goals?

Mitigation requires a major upscaling of low- and zero- carbon energy



Note: Includes baseline and idealized policy implementation scenarios. Historical data from IEA (2012a)

Electricity is seen as a particularly important area for emissions reductions in the near-term

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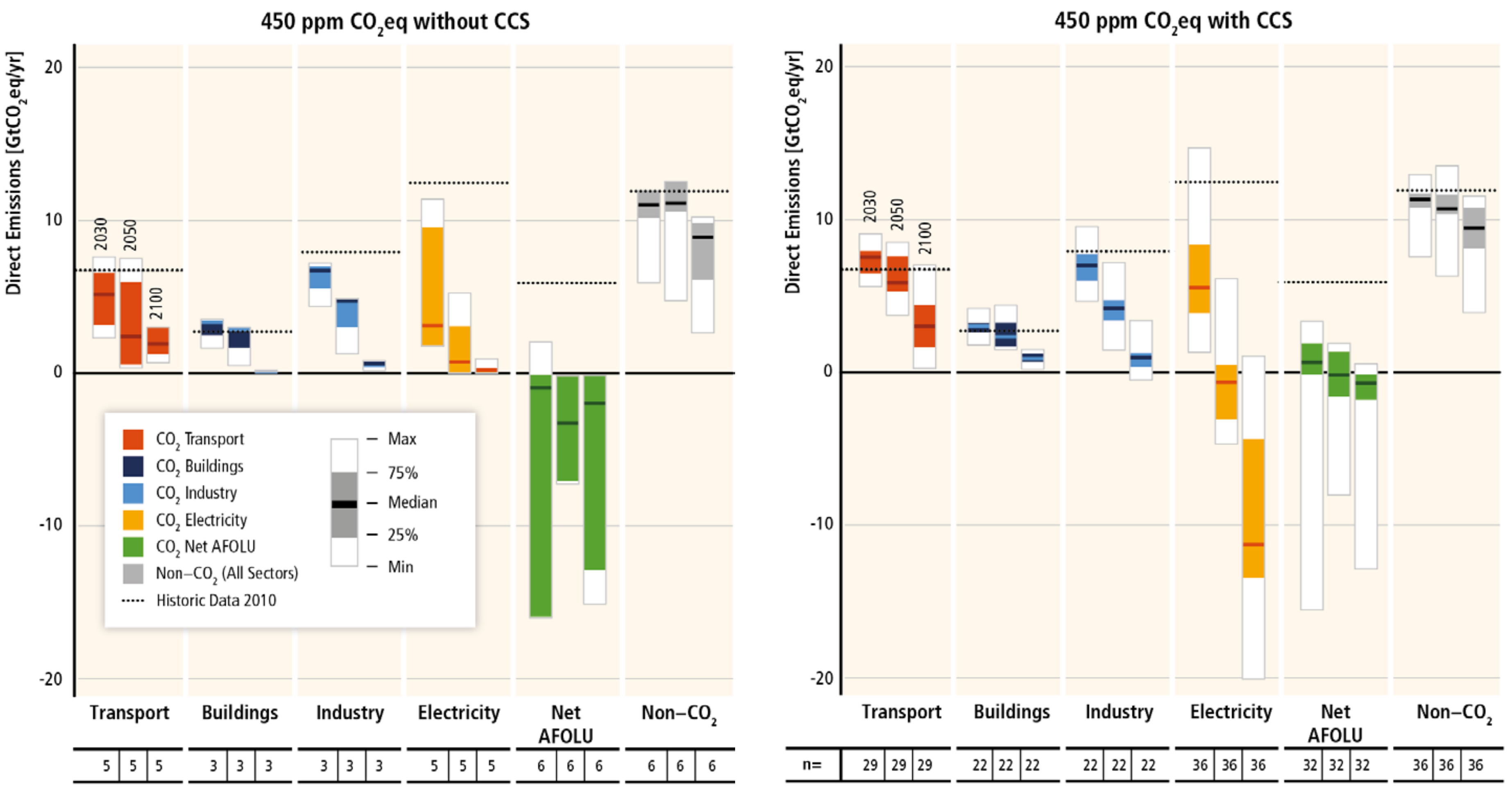
Change in Global Direct Emissions across Sectors: 450 ppm CO2e scenarios



Estimates for mitigation costs vary widely, even under idealized assumptions

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	Consumption losses in cost-effective scenarios[1] 66% range					
	[% reduction in consumption relative to baseline]			[percentage point reduction in annualized consumption growth rate]		
Concentration in 2100 (ppm CO_2eq)	2030	2050	2100	2010-2030	2010-2050	2010-2100
450 (430–480)	1.7 (1.0–3.7) [N: 14]	3.4 (2.1–6.2)	4.8 (2.9–11.4)	0.09 (0.06–0.2)	0.09 (0.06–0.17)	0.06 (0.04–0.14)
500 (480–530)	1.7 (0.6–2.1) [N: 32]	2.7 (1.5–4.2)	4.7 (2.4–10.6)	0.09 (0.03–0.12)	0.07 (0.04–0.12)	0.06 (0.03–0.13)
550 (530–580)	0.6 (0.2–1.3) [N: 46]	1.7 (1.2–3.3)	3.8 (1.2–7.3)	0.03 (0.01–0.08)	0.05 (0.03–0.08)	0.04 (0.01–0.09)
580–650	0.3 (0–0.9) [N: 16]	1.3 (0.5–2.0)	2.3 (1.2–4.4)	0.02 (0–0.04)	0.03 (0.01–0.05)	0.03 (0.01–0.05)

Both higher and lower estimates have been obtained based on interactions with pre-existing distortions, non-climate market failures, or complementary policies.

Costs can be significantly higher with inefficient implementation approaches or if particular technologies are unavailable.

These cost estimates do not account for the benefits from reduced climate change.

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Consumption grows from roughly 300% to 900% in the baseline scenarios with growth rates of 1.6% to 3.0% over the century.

These cost estimates do not account for the benefits from reduced climate change.

Substantial reductions in emissions would require large changes in investment patterns.

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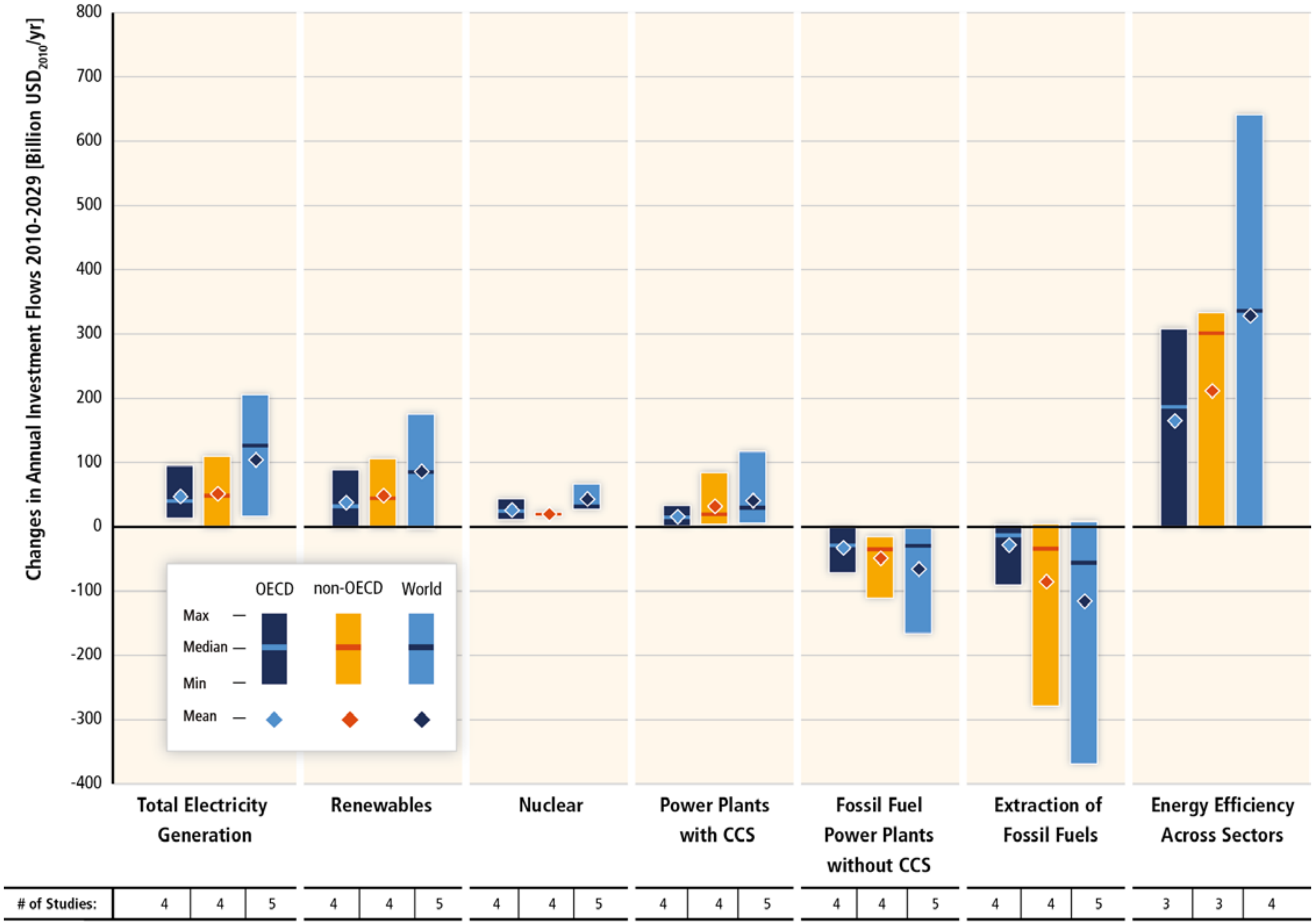
Change of average annual investment in mitigation scenarios (2010–2029)
450 ppm and 500 ppm scenarios



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The importance of near-term mitigation

Delaying mitigation will increase the challenge and narrow the options for limiting warming to 2°C.

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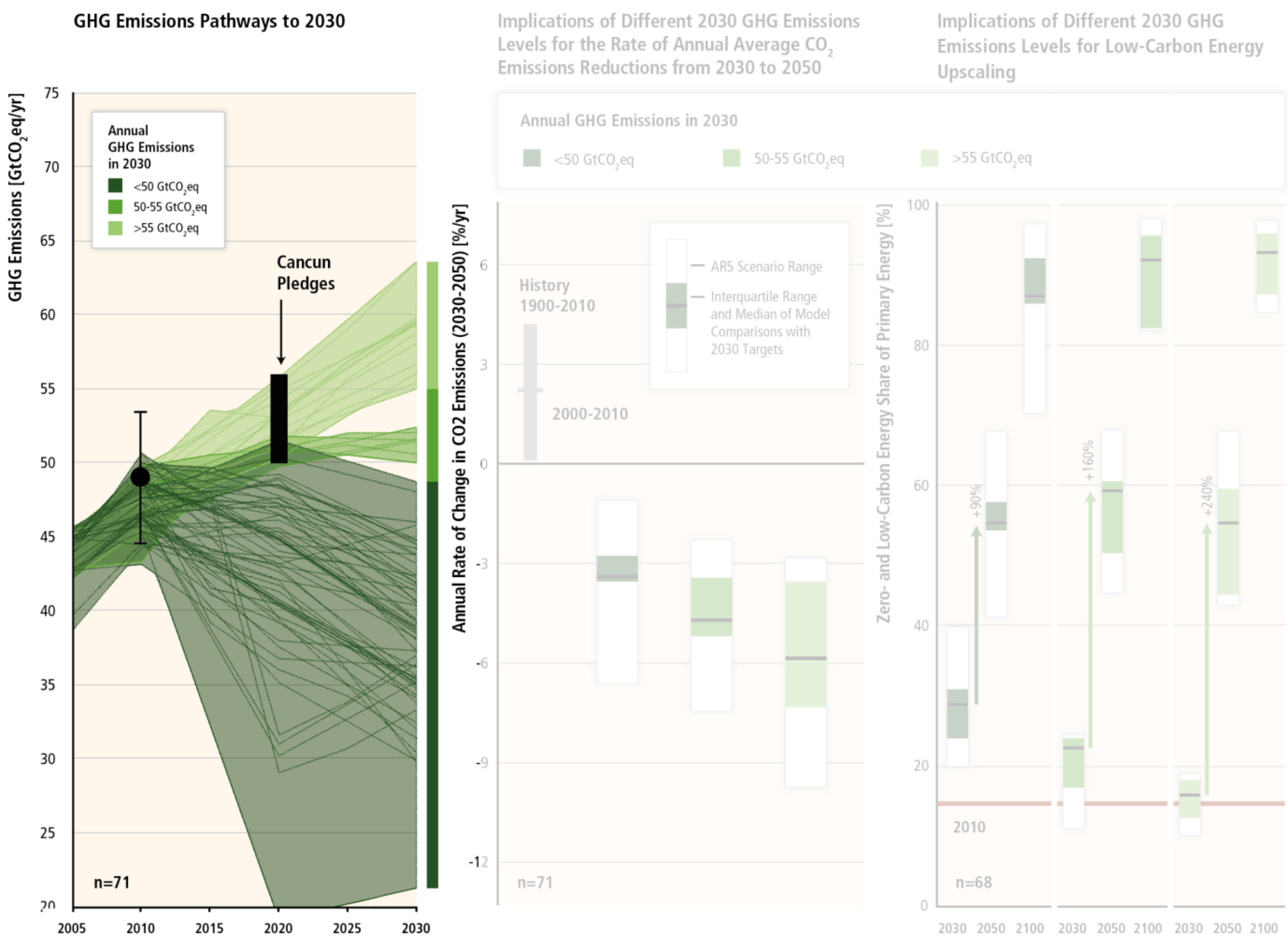
Results for Scenarios reaching about 450 or 500 ppm CO2e by 2100



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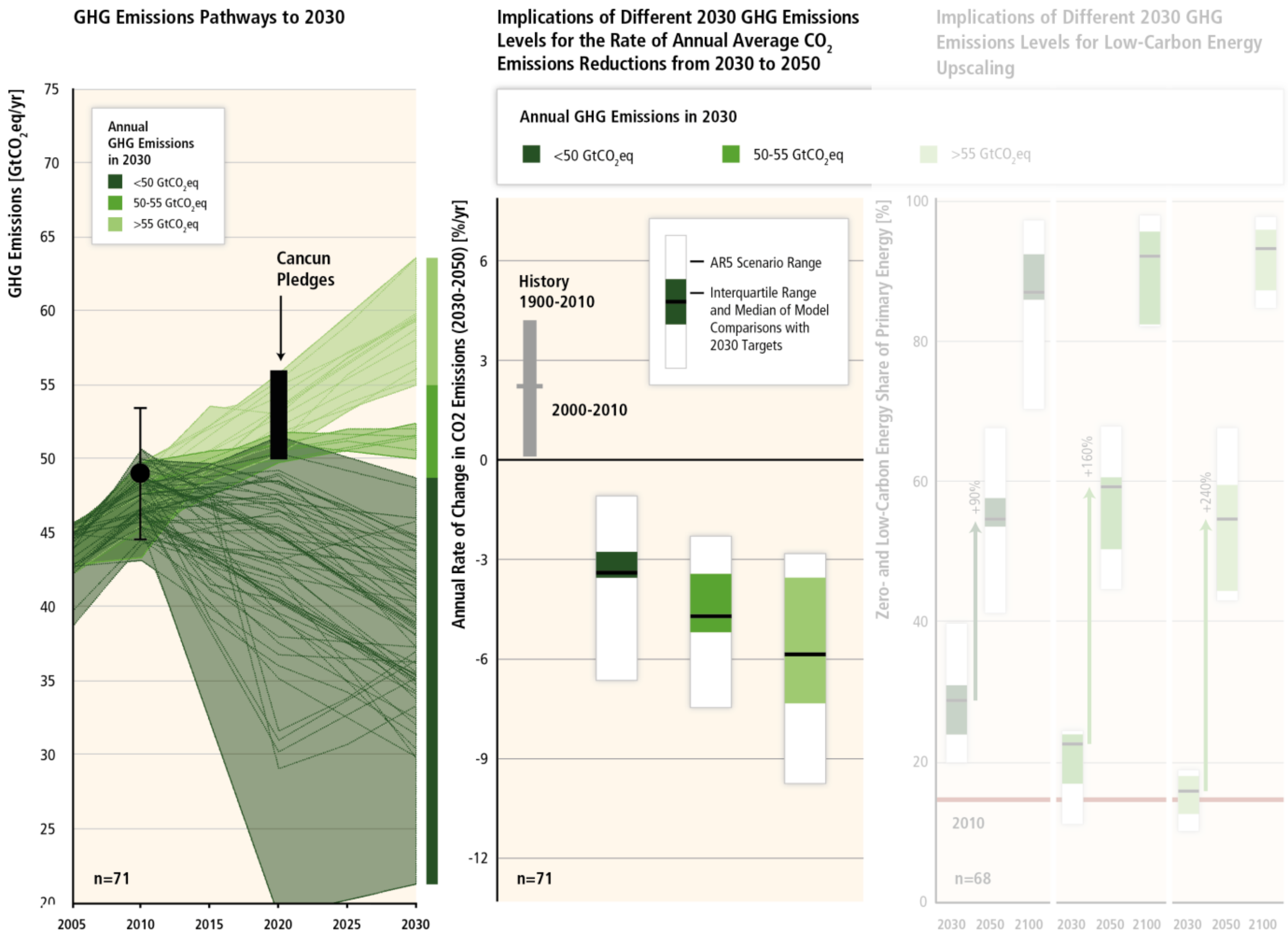

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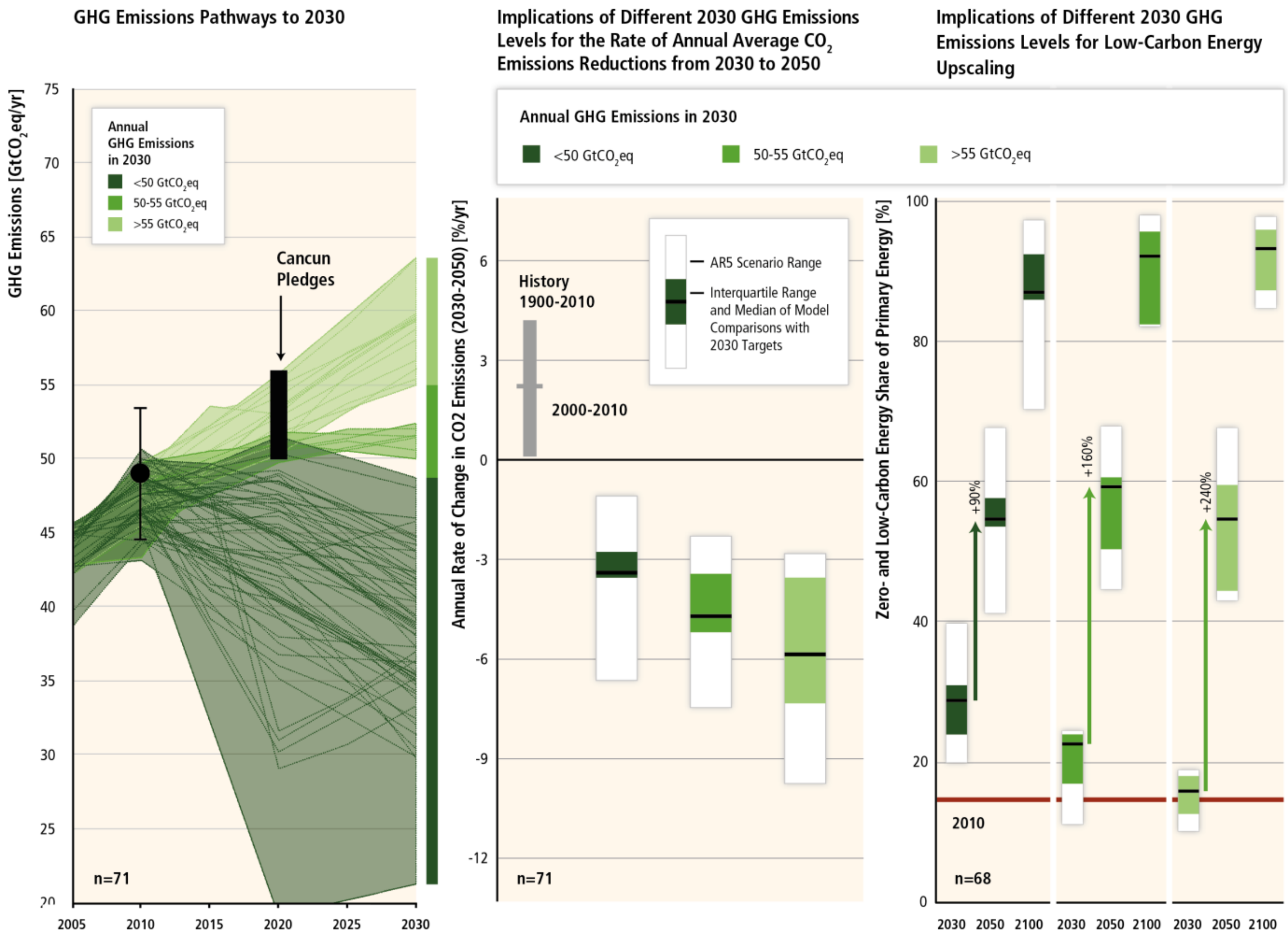
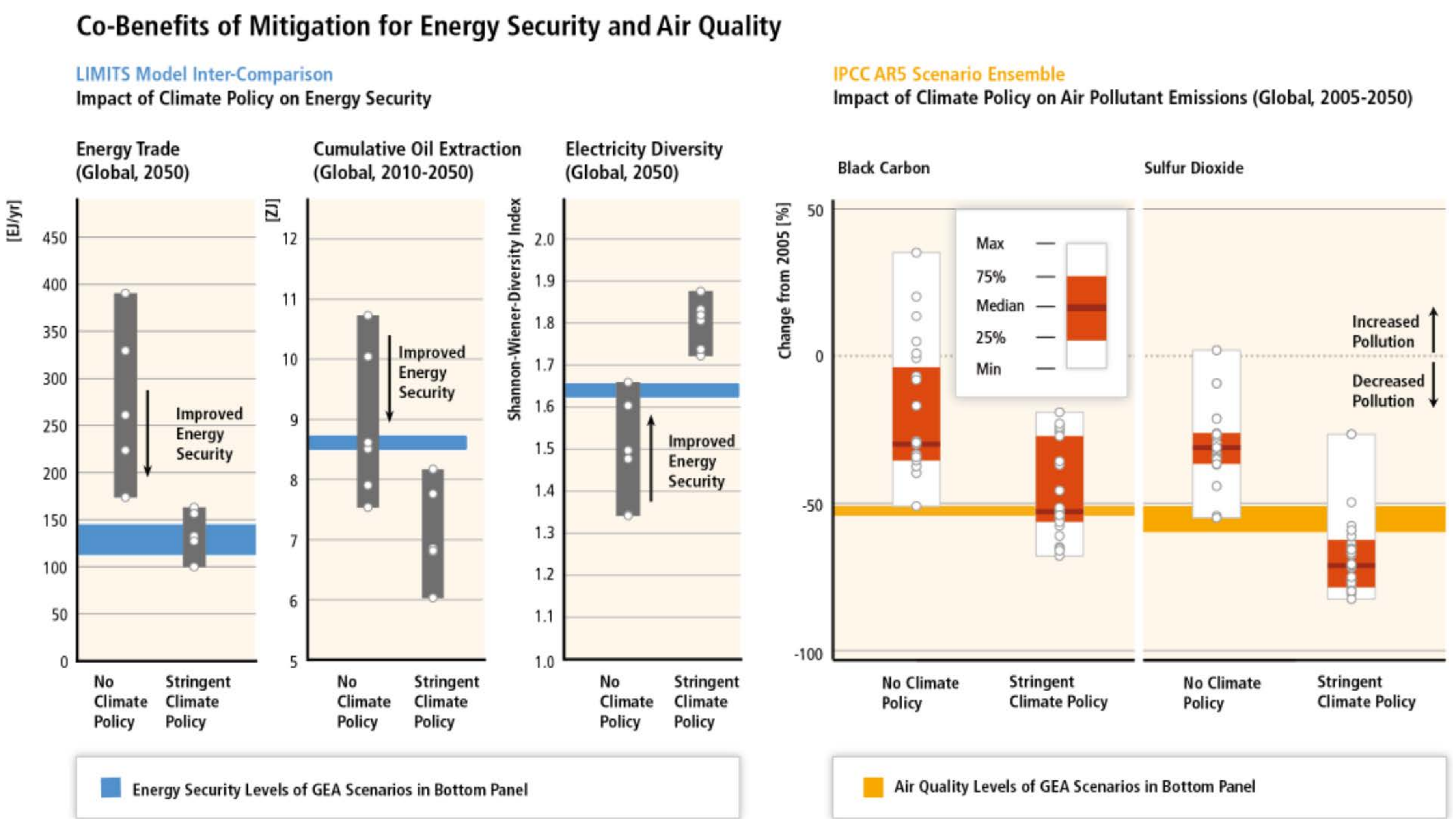


Linking to other societal priorities

AR5 has focused on the linkage from mitigation to other societal priorities.



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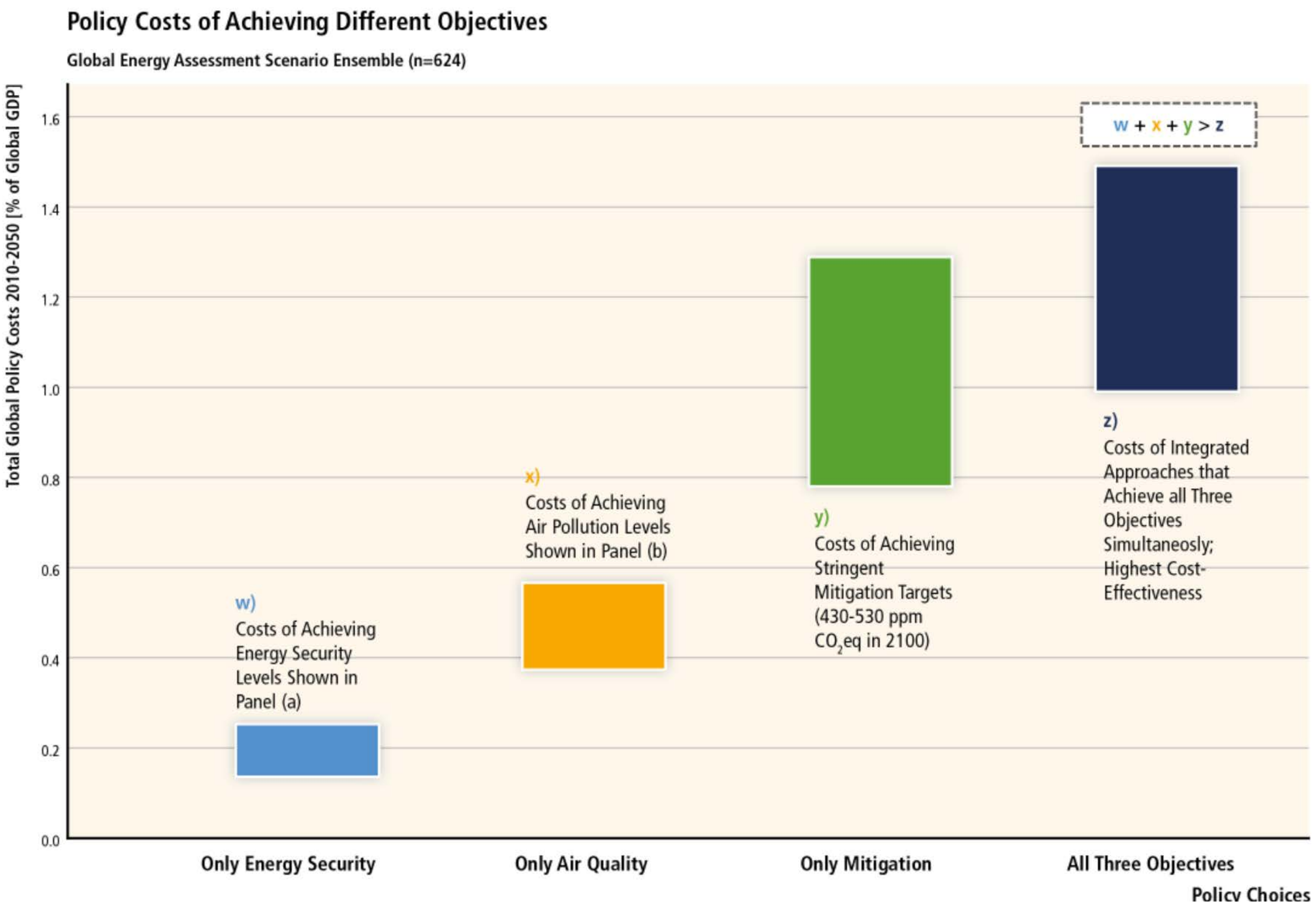

AR5 conducted a limited exploration of geoengineering

There is only limited evidence on the potential of geoengineering by CDR or solar radiation management (SRM) to counteract climate change, and all techniques carry risks and uncertainties *(high confidence)***.** A range of different SRM and CDR techniques has been proposed, but no currently existing technique could fully replace mitigation or adaptation efforts. Nevertheless, many low-GHG concentration scenarios rely on two CDR techniques, afforestation and biomass energy with carbon dioxide capture and storage (BECCS), which some studies consider to be comparable with conventional mitigation methods. Solar radiation management could reduce global mean temperatures, but with uneven regional effects, for example on temperature and precipitation, and it would not address all of the impacts of increased CO_2 concentrations, such as ocean acidification. Techniques requiring large-scale interventions in the earth system, such as ocean fertilization or stratospheric aerosol injections, carry significant risks. Although proposed geoengineering techniques differ substantially from each other, all raise complex questions about costs, risks, governance, and ethical implications of research and potential implementation. [6.9]

Discussion