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# Probable Climates

**Hyae Ryung Kim, Anika Behrndt, Zacharia Thurston,  
Isabel Hoyos, and Gernot Wagner**

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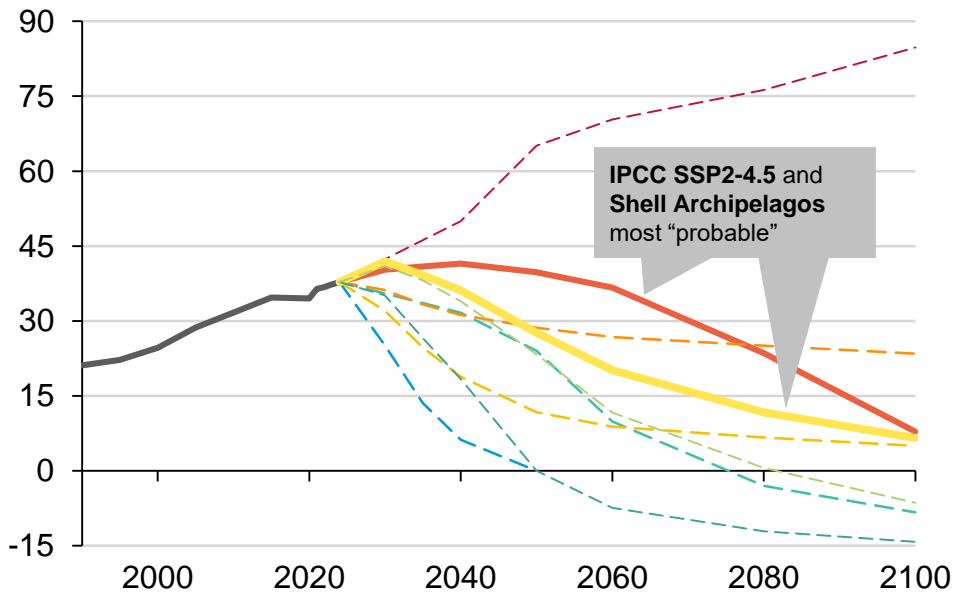
# Early decarbonization investments are key to keeping temperatures within livable range and saving trillions in climate costs

Even the least-ambitious Shell scenario reaches near-zero emissions by 2100, but speed is essential to avoid the worst climate impacts and runaway economic costs

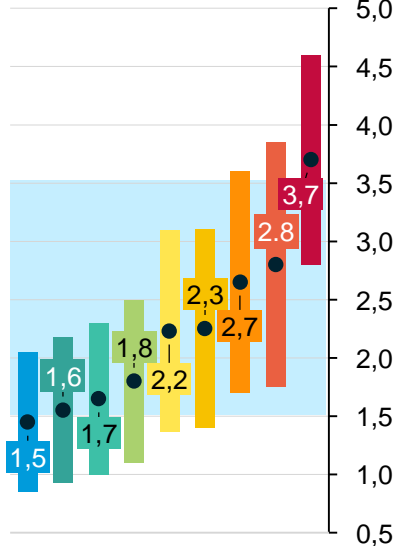
Low-carbon investment has risen rapidly recently, though ~2.5-3.5x gap remains

- IPCC SSP1-2.6    — IEA Net Zero by 2050    — Shell Archipelagos    ● Median
- IPCC SSP2-4.5    — IEA Announced Pledges    — Shell Horizon    ■ “Likely” ranges
- IPCC SSP3-7.0    — IEA Stated Policies    — Shell Surge    ■ “Probable” outcomes

Annual global CO<sub>2</sub> emissions, GtCO<sub>2</sub>



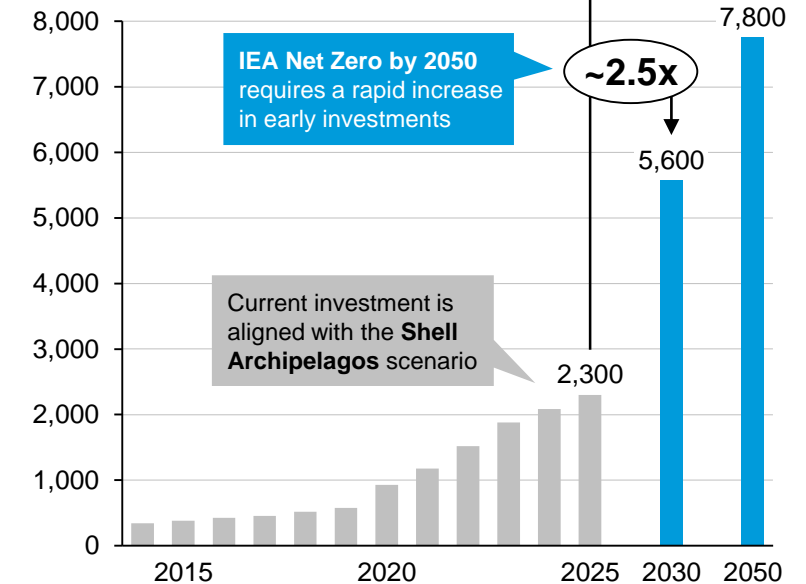
Projected average global warming<sup>1</sup>, °C



Climate impacts, % GDP loss



Annual investments, US\$B



<sup>1</sup> Global warming by 2100 above 1850-1900 average, with 66% “likely” ranges. “Probable” ranges are based on own best estimate of current trends.

<sup>2</sup> Global warming of >2°C is expected to trigger tipping points with large, highly uncertain costs — e.g., Moore et al., *PNAS* (2024); Dietz et al., *PNAS* (2021).

Sources: IPCC, *Climate Change Synthesis Report* (2023); Shell, *The Energy Security Scenarios* (2025); IEA, *World Energy Outlook* (2024); Nature, *Emissions – the ‘business as usual’ story is misleading* (2020); BNEF, *Energy Transition Investment Trends* (2026).

Credit: Anika Behrndt, Zacharia Thurston, Isabel Hoyos, Hyaee Ryung Kim, and Gernot Wagner. Share with attribution: Wagner et al., “Probable Climates” (27 January 2026).

# Each fractional degree of additional warming multiplies ecological and human climate-related damages across scenarios

World outlook in 2100 according to low-, medium-, and high-ambition IEA climate scenarios

	Indicators		Costs	Implications				
	Global warming <sup>1</sup>	Global mean sea-level rise	Estimated GDP loss (in US\$)	Population exposed to drought and heat stress	Coral reef loss	Arctic ice loss	Increase in people affected by coastal flooding	Increase in people in hunger
IEA Stated Policies	2.7°C	50-81 cm	~15%	~1.3B	Near total loss	Likely every summer ice free before 2100	N/A	80 million
IEA Announced Pledges	2.3°C	40-69 cm	~6-8%	~1.15B	>99%	Likely summer ice free at least once before 2100	30%	24 million
IEA Net Zero by 2050	1.5°C	34-59 cm	~3-5%	~1B	~70-90%	Possibly retains summer ice	24%	8 million

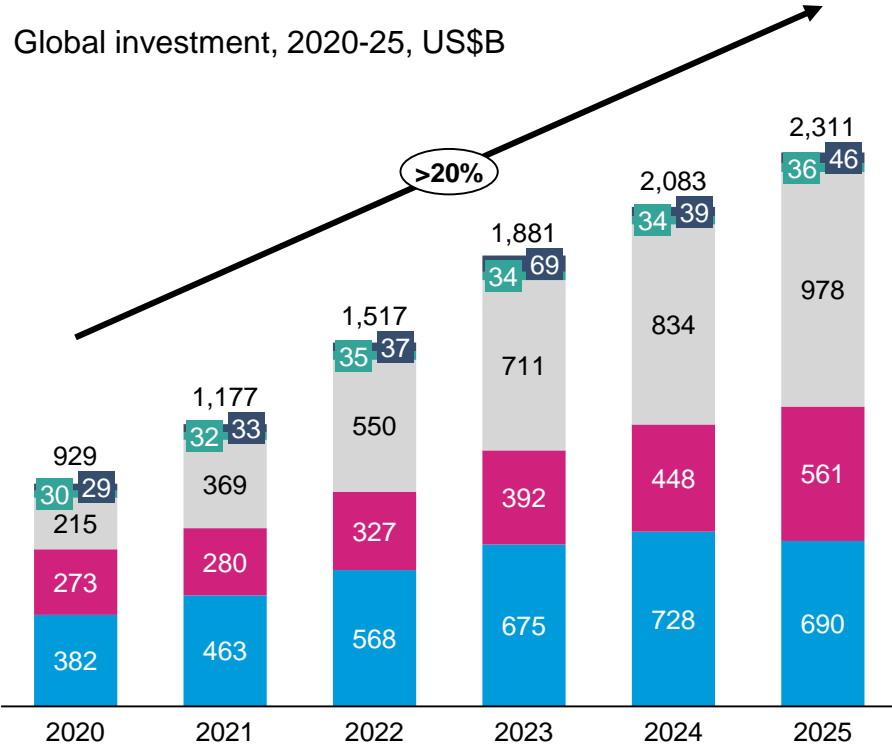
<sup>1</sup> Average global warming above 1850-1900 average.

Sources: Global warming: IEA, [World Energy Outlook](#) (2024); Sea-level rise extrapolated from IPCC SSP1, SSP2, and SSP3: [IPCC Sixth Assessment Report](#) (2021); Estimated GDP losses based on approximations by NGFS: [NGFS long-term scenarios for central banks and supervisors](#) (2018); Pop. exposed to heat stress: IPCC, [Climate Change 2022: Impacts, Adaptation and Vulnerability](#) (2022); Coral reef loss: IPCC, [Summary for Policymakers — Global Warming of 1.5 °C](#) (2018); Arctic ice loss extrapolated from IPCC scenarios: [Summary for Policymakers](#) (2018); People affected by floods: IPCC, [Climate Change 2022](#) (2022); Increase in people in hunger based on IPCC scenarios 1, 2, and 3: IPCC, [Special Report on Climate Change and Land: Food Security](#) (2019).  
Credit: Anika Behrndt, Isabel Hoyos, Hyaee Ryung Kim, and [Gernot Wagner](#). [Share with attribution](#): Wagner et al., "Probable Climates" (27 January 2026).

# Global clean energy investment grew at >20% CAGR from 2020 to 2025, with renewables deployment in Asia leading the charge

**Electrification overtakes renewables as global clean energy investments accelerate**

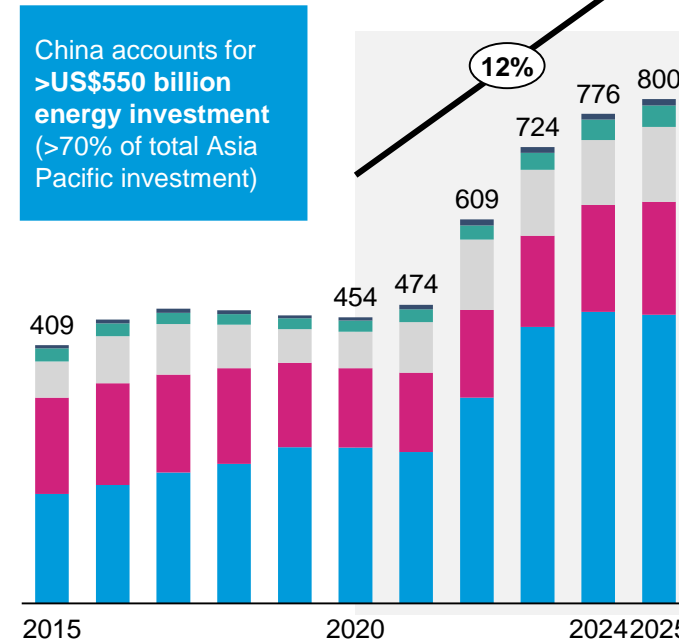
Renewables    Electrification    Other emerging technologies  
 Grid & storage    Nuclear



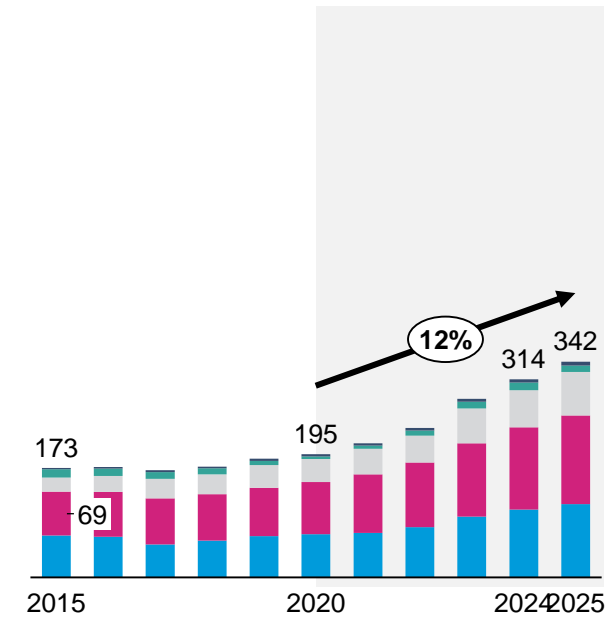
**Asia heavily and rapidly investing in renewables (>10% CAGR, 2015-25); North America investing steadily, focused on renewables, grids, and storage**

Renewables    Grid & storage    Electrification    Nuclear    Other emerging technologies

Asia investment, 2015-25, US\$B



North America investment, 2015-25, US\$B



Note: BloombergNEF technology categories were consolidated into five broader sectors: (1) renewables, (2) grid & storage, (3) electrification of end-use sectors (transport, heat), (4) other emerging solutions (clean industry, hydrogen, CCUS), and (5) nuclear. Grouping was based on primary function within the energy-transition value chain. The regional investment breakdown is based on IEA data, with electrification extrapolated from the "Other end uses" section. The share of electrification (92%) of other end uses and emerging technologies is based on the Bloomberg NEF proxy. Sources: IEA, [World Energy Investment 2025](#) (2025); BloombergNEF, [Energy Transition Investment Trends](#) (2025).

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