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SABIN CENTER FOR CLIMATE CHANGE LAW

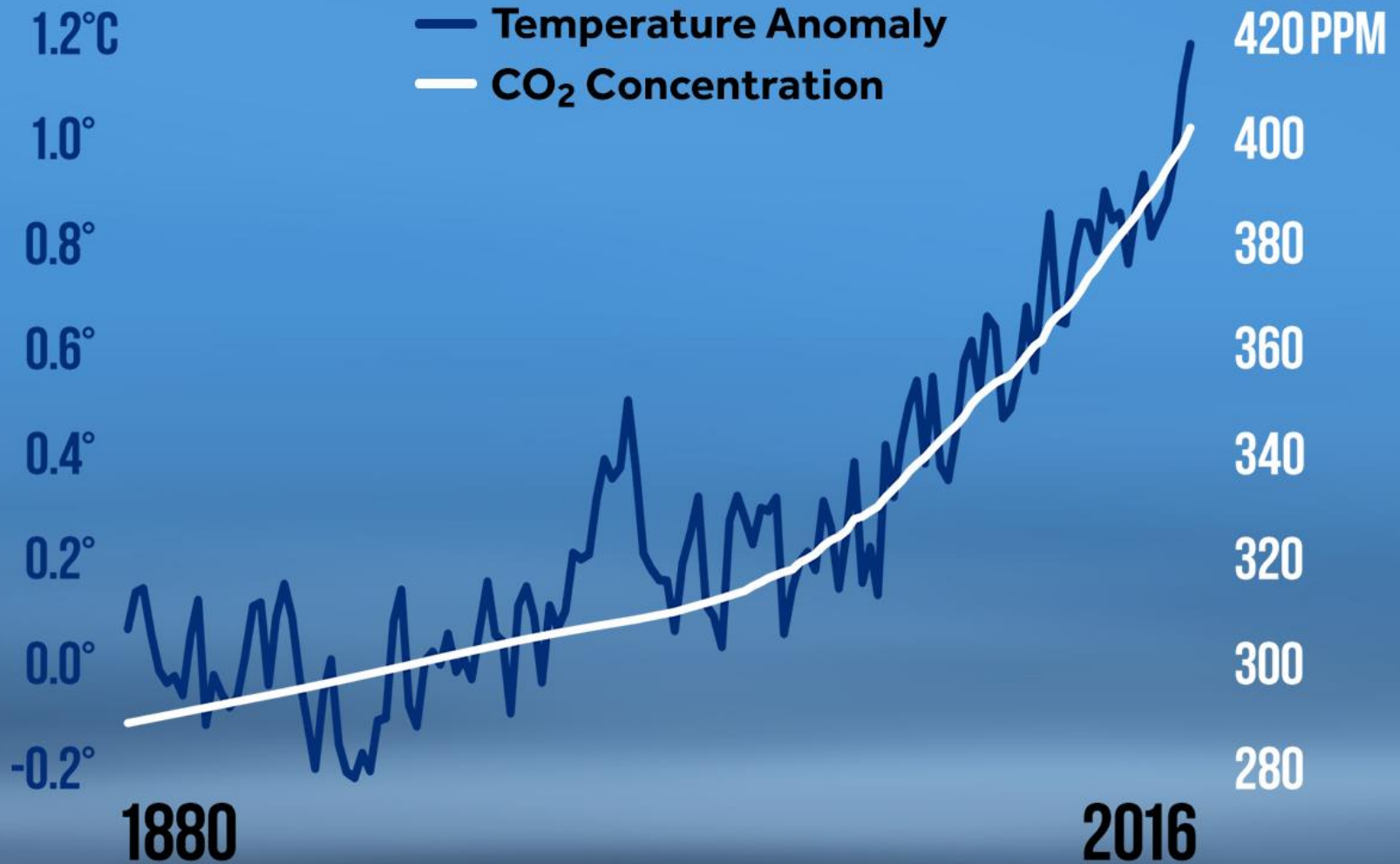
Climate Change Risks and Opportunities: What the Paris Agreement Means for Business

Michael Burger
Executive Director,
Sabin Center for Climate Change Law

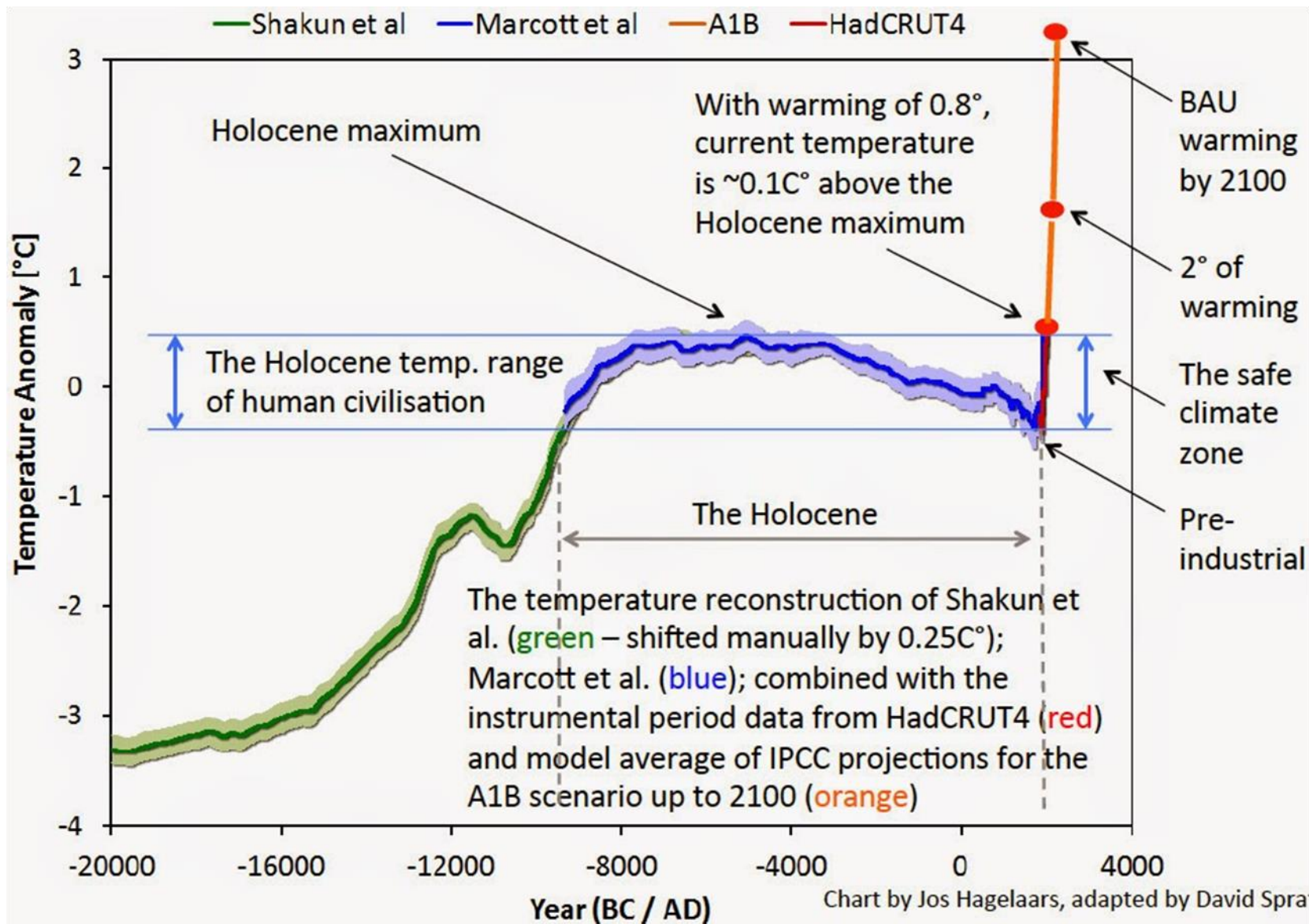
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April 19, 2018

Global Temperature and Carbon Dioxide

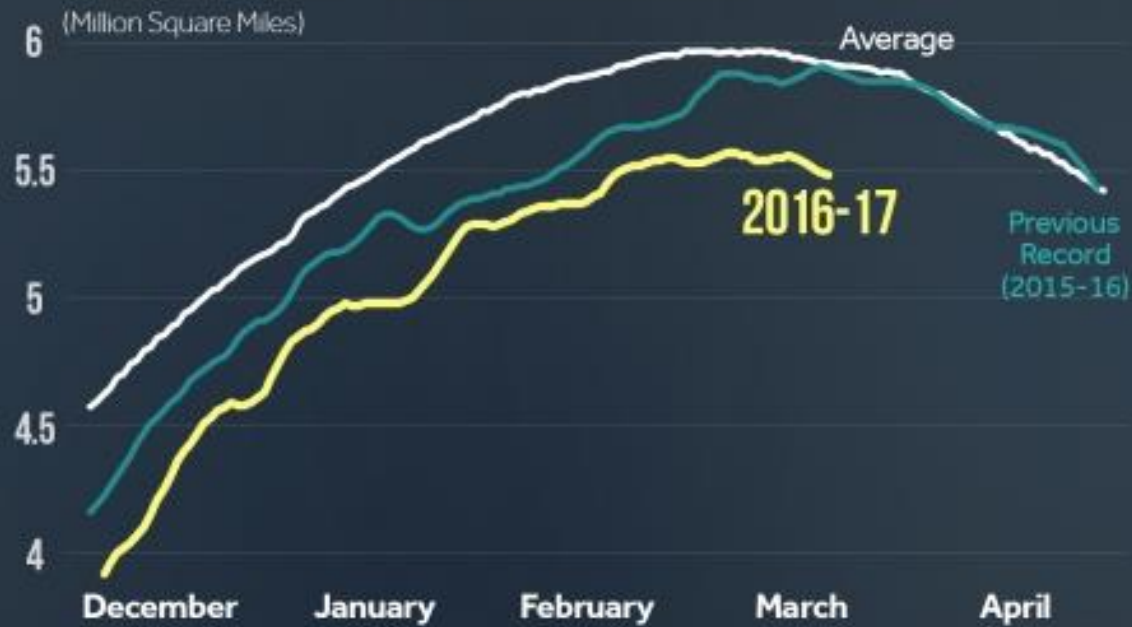


Global temperature data averaged and adjusted to early industrial baseline (1881-1910).
Source: NASA GISS, NOAA NCEI, ESRL



Global temperature and the Holocene safe-climate zone

Record-Low Arctic Sea Ice Max Area of Arctic Sea Ice Extent

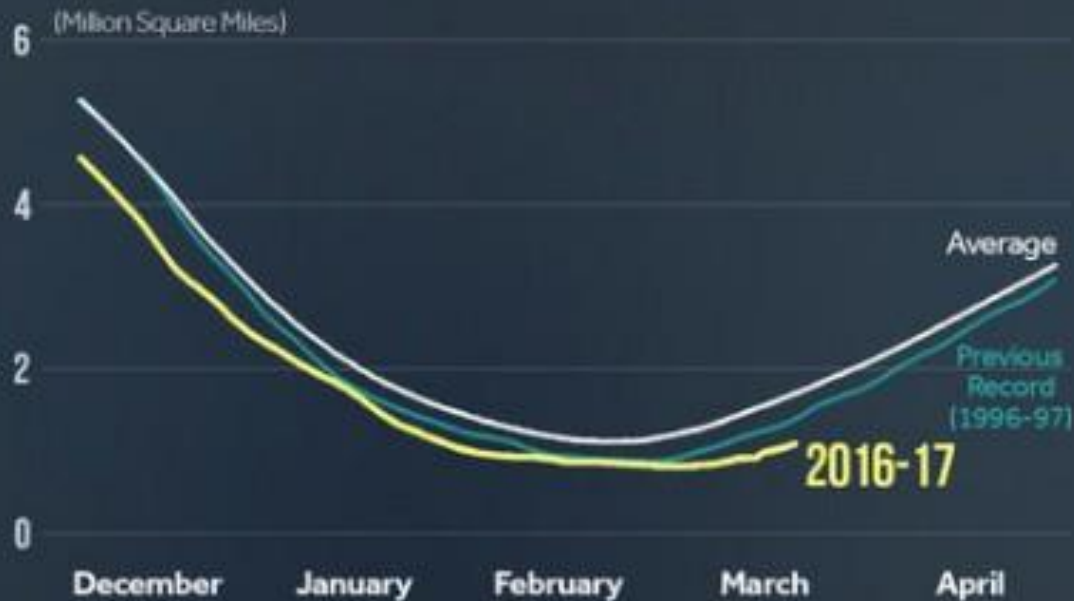


Area of Ocean with at Least 15% Ice
Source: National Snow and Ice Data Center


CLIMATE  CENTRAL

RECORD-LOW ANTARCTIC SEA ICE

Area of Antarctic Sea Ice Extent



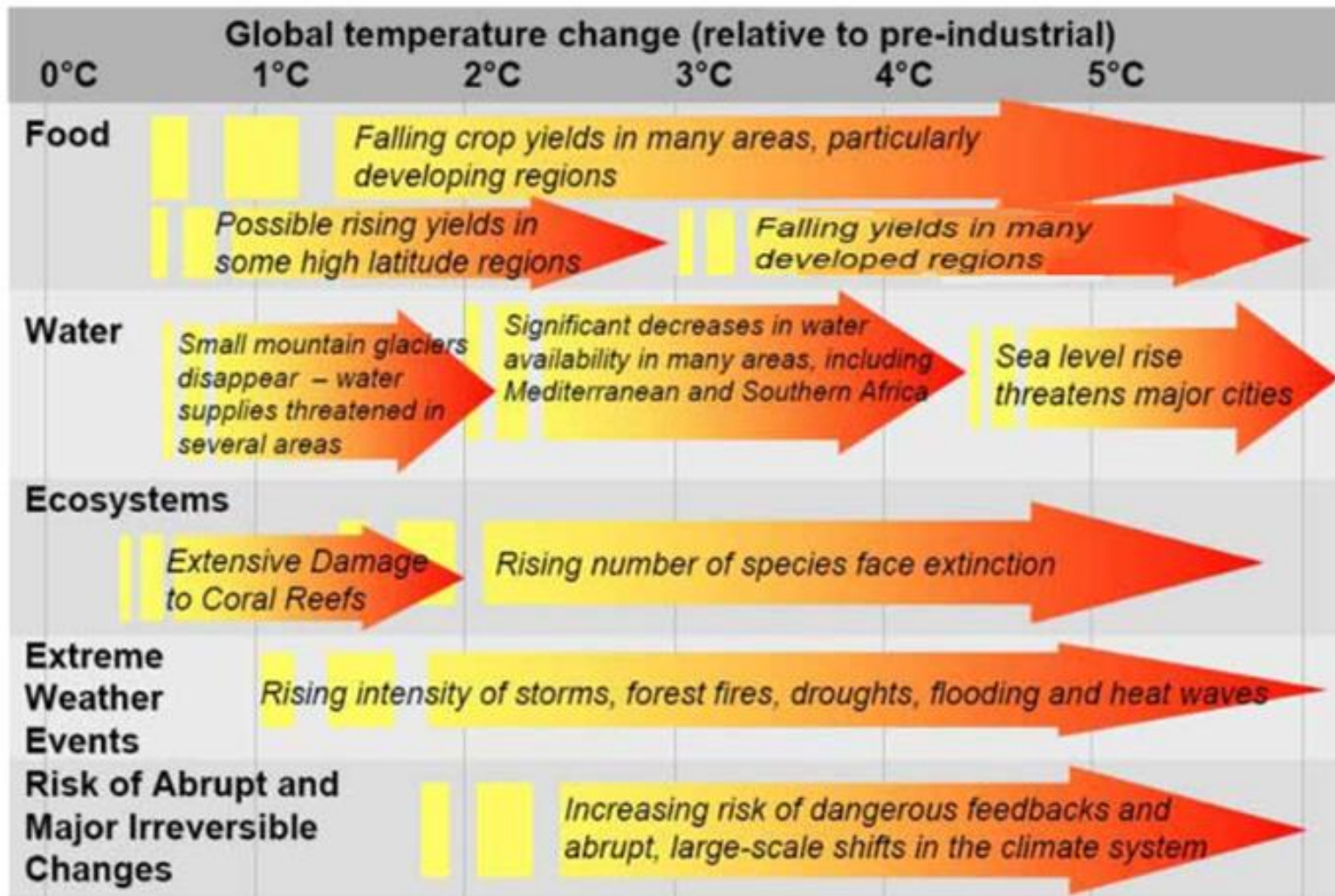
Area of Ocean with at Least 10% Ice
Source: National Snow and Ice Data Center

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Climate change impacts

Stern Commission



From UK Stern Commission Economics of climate change 2006

Climate Risks to Sustainable Development

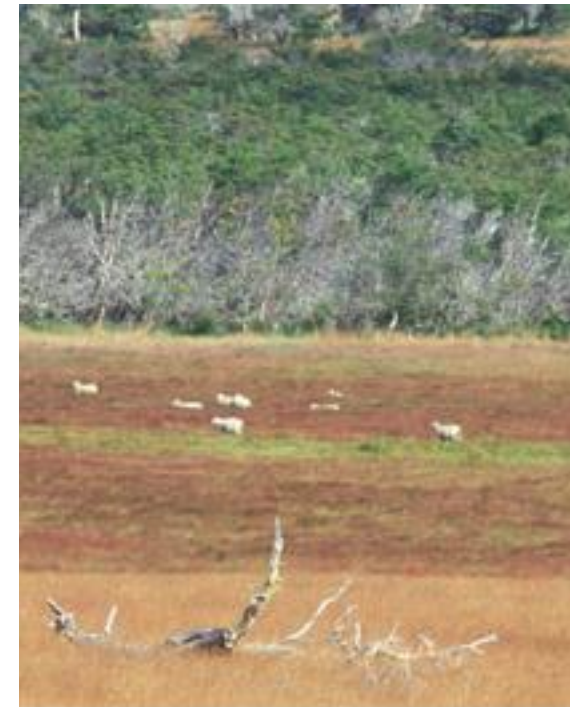
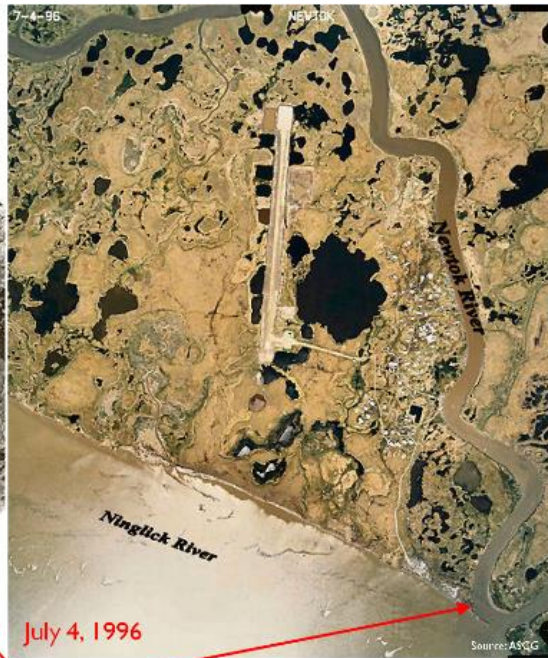
- Existential Risks
- Slow Onset Risks
- Disaster Risks
- Cross-cutting Risks
 - Food security
 - Poverty eradication



Existential Risks



Slow Onset Risks: Gradual Degradation of Land and Habitats



Slow Onset Risks: Drought and Desertification



Disaster Risks



▲ People walk along a street after a flood last week in Copiapó, Chile. Photograph: Felipe Trueba/EPA



Climate change and the wildfires in Chile



Cross-Cutting Risks: Food Security and Poverty Eradication



Nations Unies
Conférence sur les Changements Climatiques

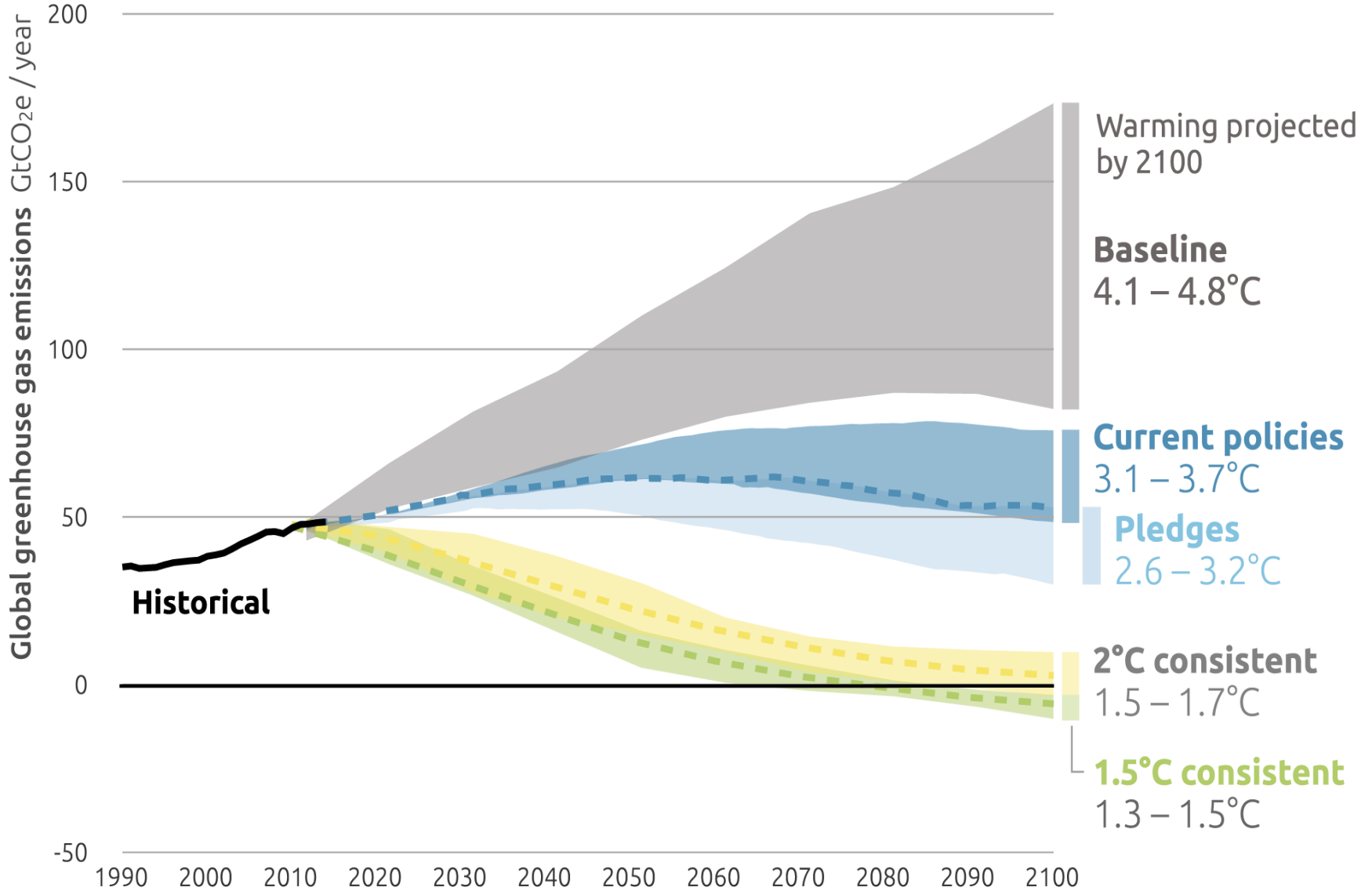
COP21/CMP11

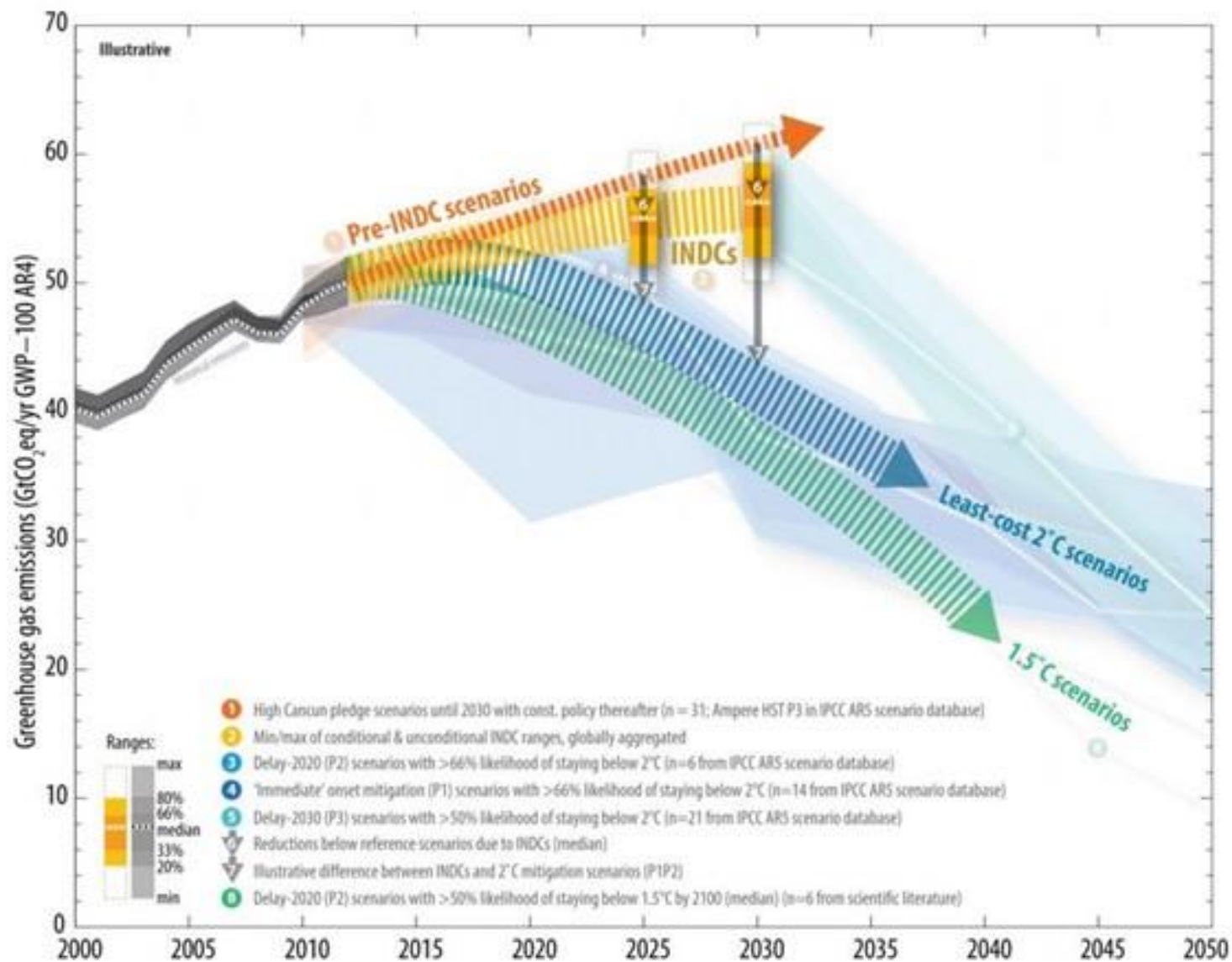
Paris, France



2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies

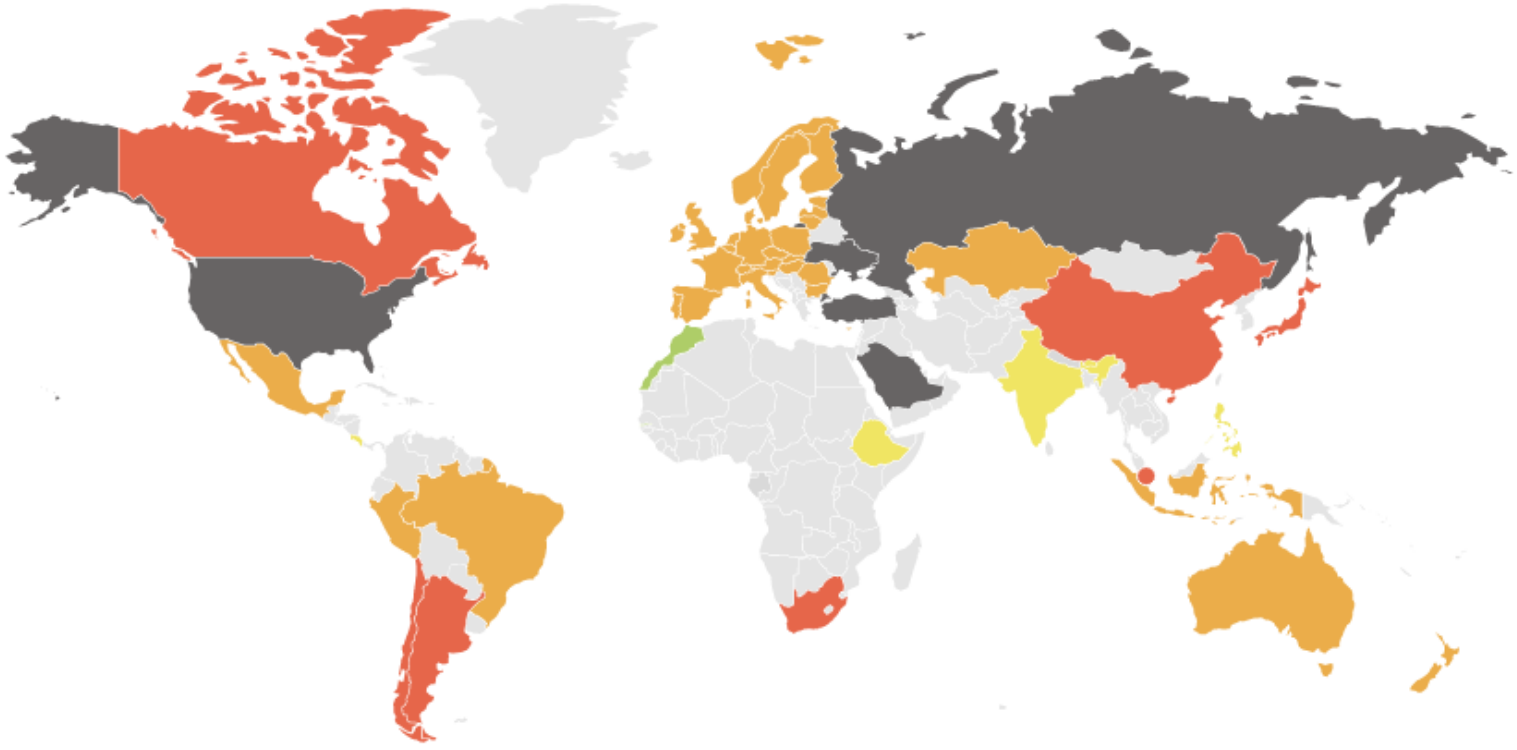




Sources: Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report scenario database, 1.5 °C scenarios from scientific literature (see footnote 19), IPCC historical emission database and intended nationally determined contribution quantification.

Individual country assessments

Select a country from the map below to view their individual assessment



CRITICALLY INSUFFICIENT
Commitments with this rating fall well outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would exceed 4°C.

HIGHLY INSUFFICIENT
Commitments with this rating fall outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C.

INSUFFICIENT
Commitments with this rating are in the least stringent part of their fair share range and not consistent with holding warming below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach over 2°C and up to 3°C.

2°C COMPATIBLE
Commitments with this rating are consistent with the 2009 Copenhagen 2°C goal and therefore fall within the country's fair share range, but are not fully consistent with the Paris Agreement. If all government targets were in this range, warming could be held below, but not well below, 2°C and still be too high to be consistent with the Paris Agreement 1.5°C limit.

1.5°C PARIS AGREEMENT COMPATIBLE
This rating indicates that a government's efforts are in the most stringent part of its fair share range: it is consistent with the Paris Agreement's 1.5°C limit.

ROLE MODEL
This rating indicates that a government's efforts are more ambitious than what is considered a fair contribution: it is more than consistent with the Paris Agreement's 1.5°C limit.

FAIR SHARE RANGE

4°C

3°C

2°C

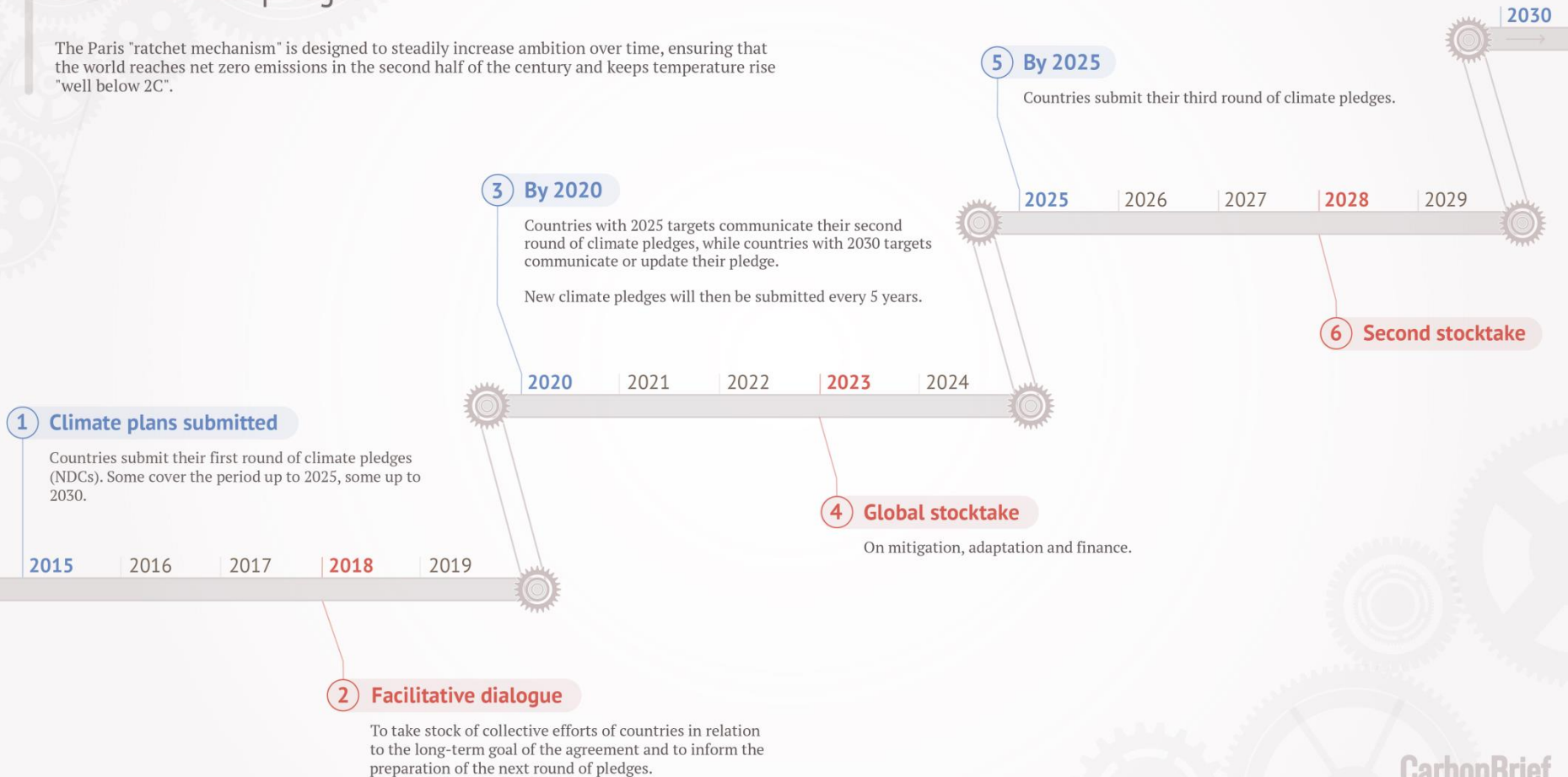
1.5°C

Paris Decision, Article 3

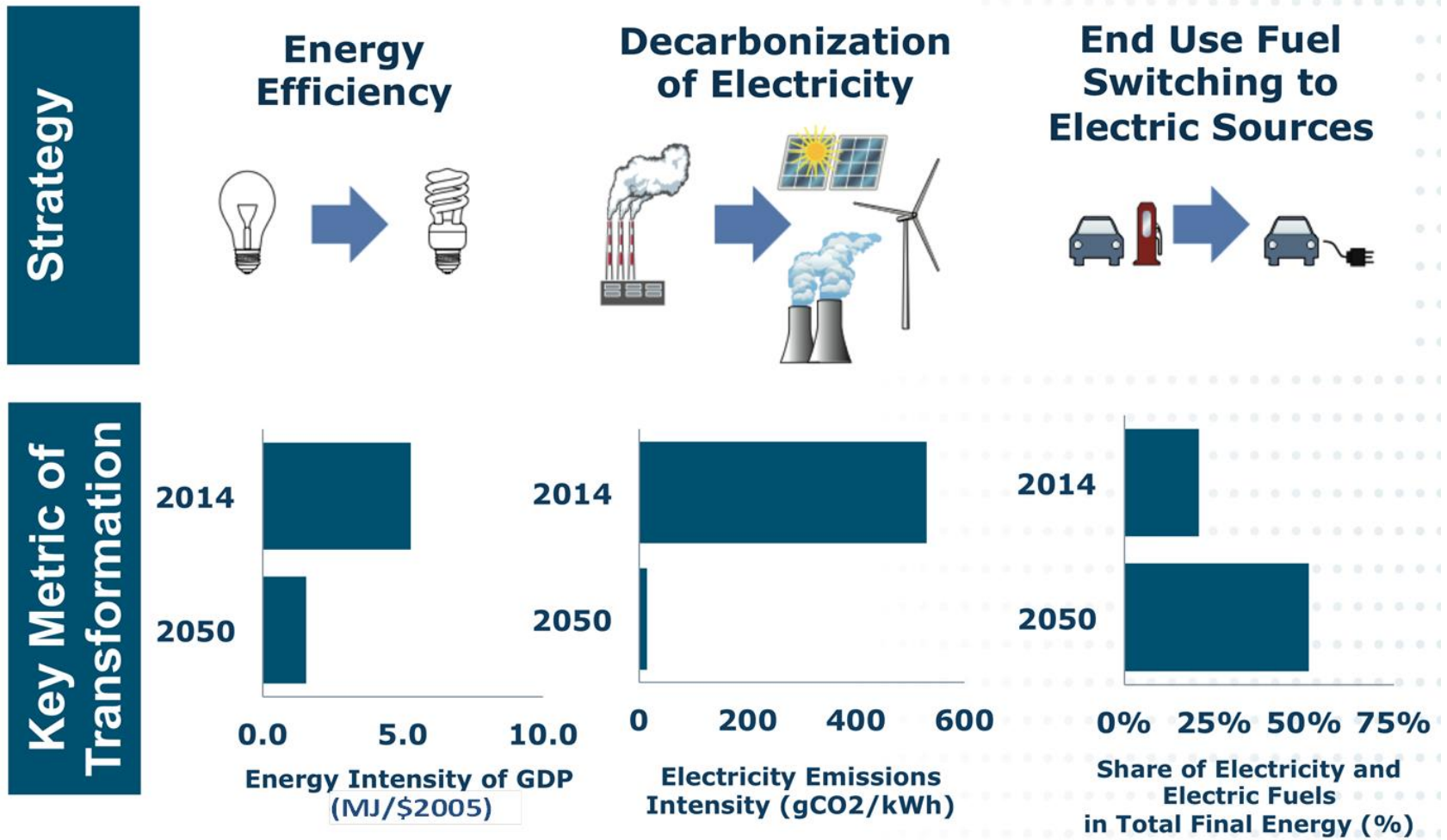
As nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate ambitious ... with the view to achieving the purpose of this Agreement as set out in Article 2. **The efforts of all Parties will represent a progression over time**, while recognizing the need to support developing country Parties for the effective implementation of this Agreement.

Timeline: How countries plan to raise the ambition of their climate pledges

The Paris "ratchet mechanism" is designed to steadily increase ambition over time, ensuring that the world reaches net zero emissions in the second half of the century and keeps temperature rise "well below 2C".



Three Pillars of Deep Decarbonization

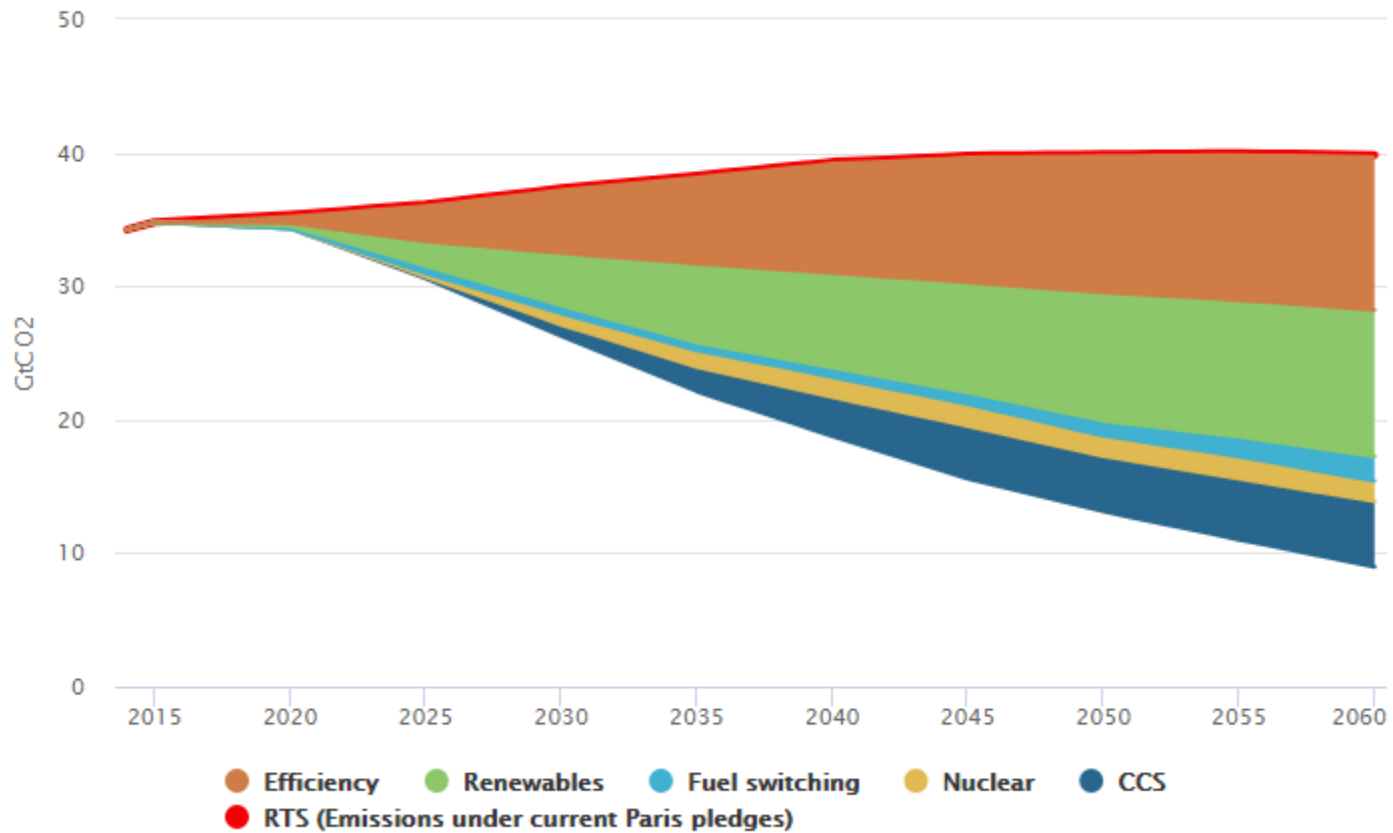


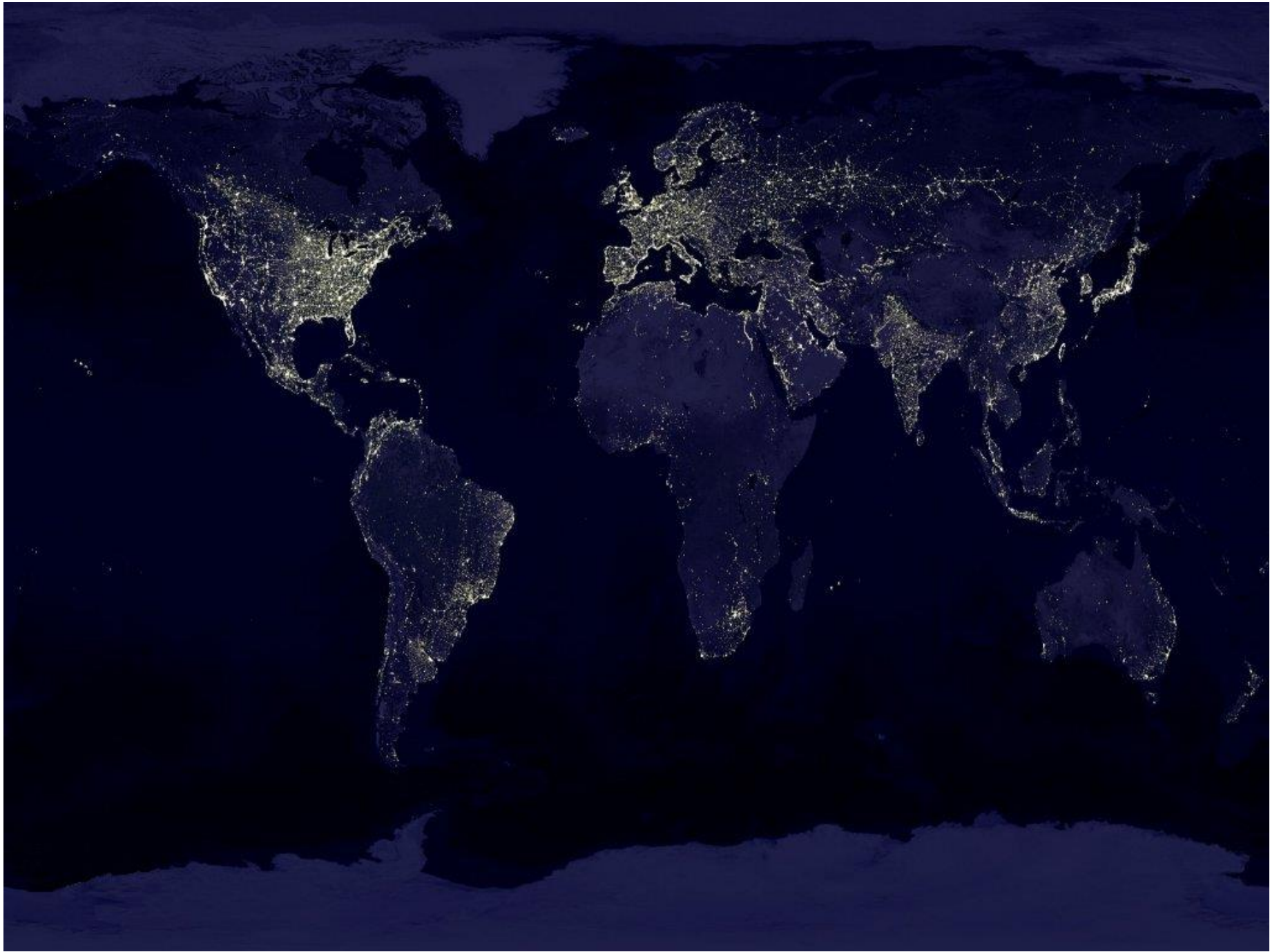
Pathways to Deep Decarbonization in the United States, Mixed case results

How each technology area contributes to CO2 emissions reductions



ETP 2DS Scenario. Click a technology in the legend to show/hide.

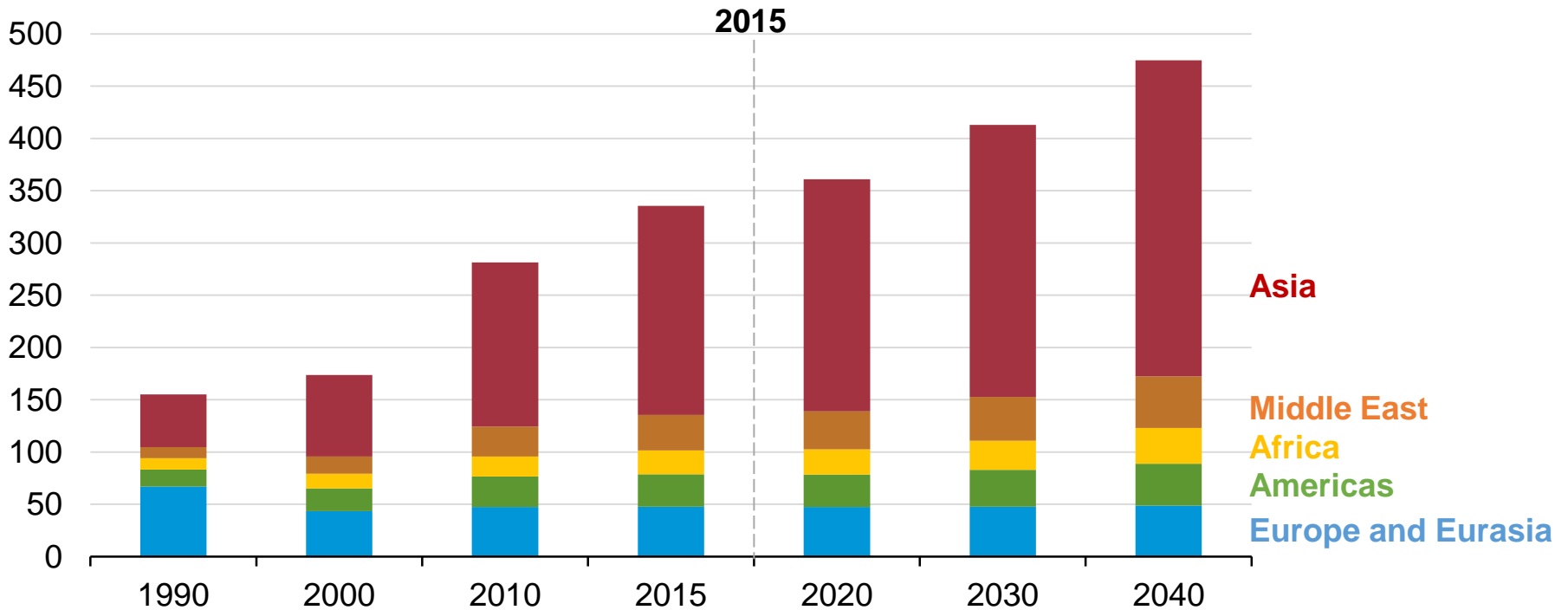






In the Reference case, Asia accounts for most of the increase in energy use in non-OECD regions—

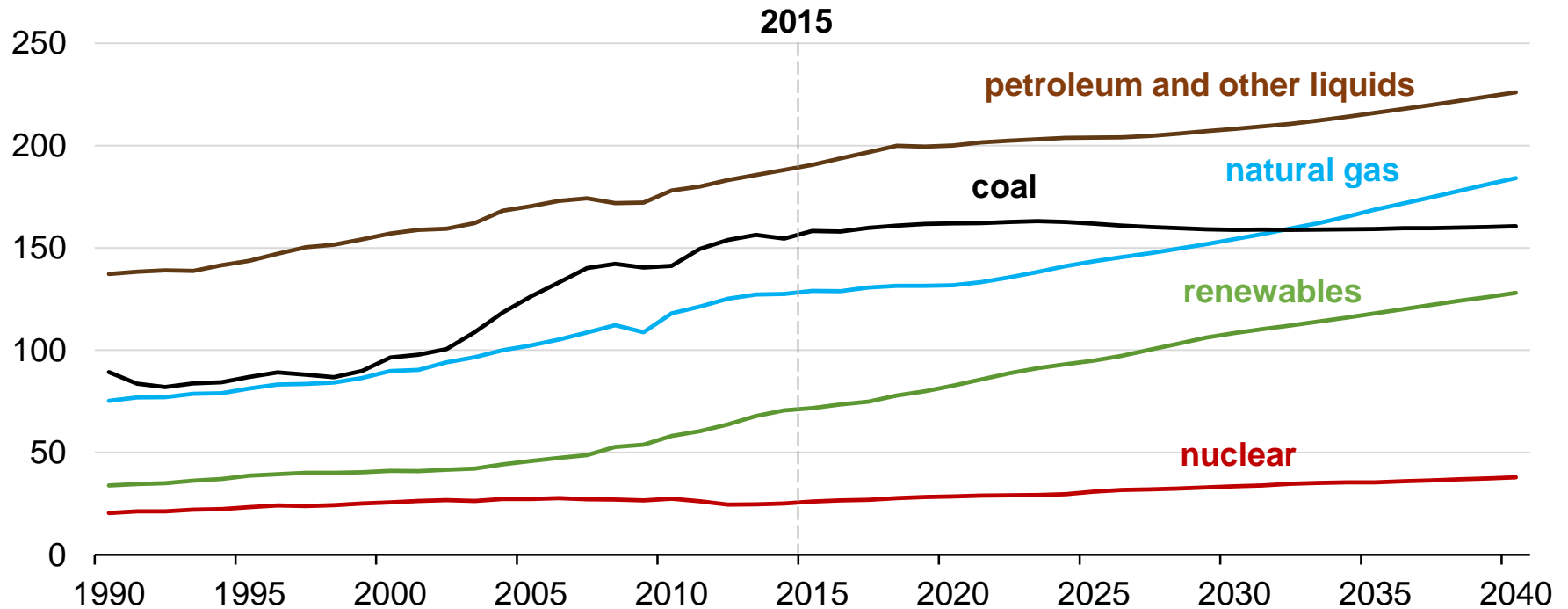
Non-OECD energy consumption by region
quadrillion Btu





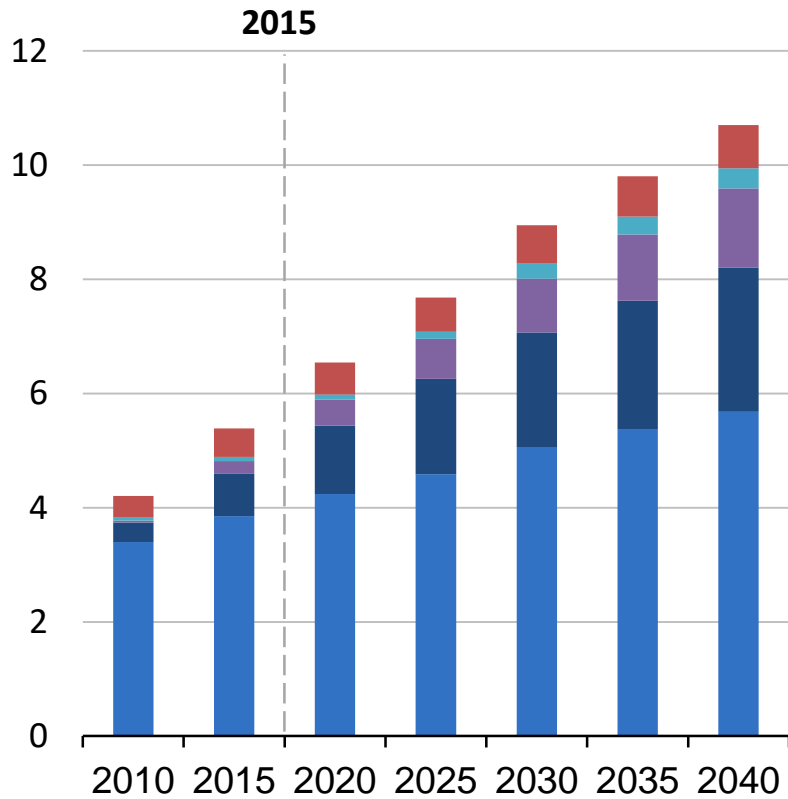
Energy consumption increases over the projection for all fuels other than coal in the Reference case—

World energy consumption by energy source
quadrillion Btu

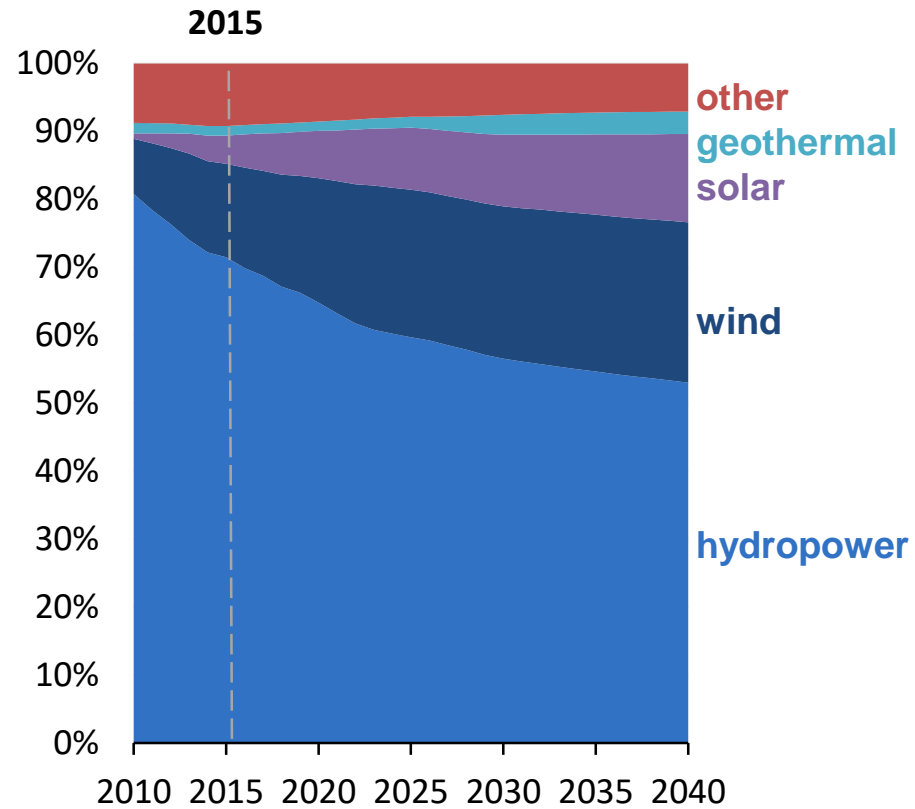


Wind and solar dominate growth in renewables—

World net electricity generation from renewable power
trillion kilowatthours



percent share of renewable energy



Source: Energy Information Agency, *International Energy Outlook 2017*

Falling Costs for Clean Energy Technologies

Indexed Cost Reductions Since 2008

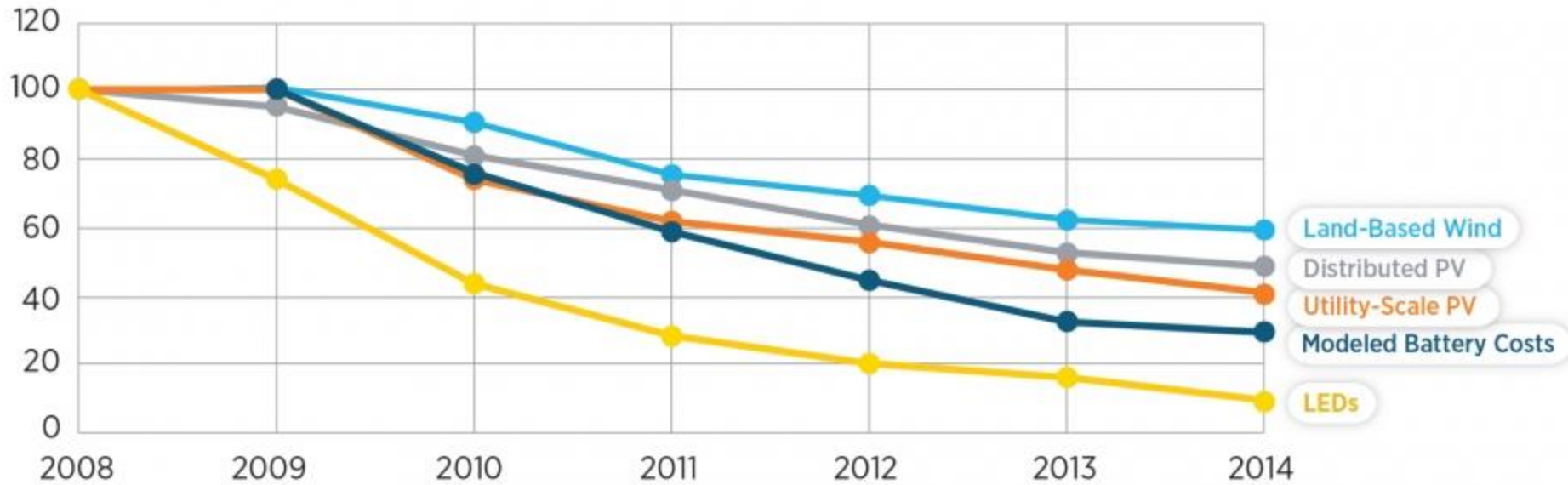
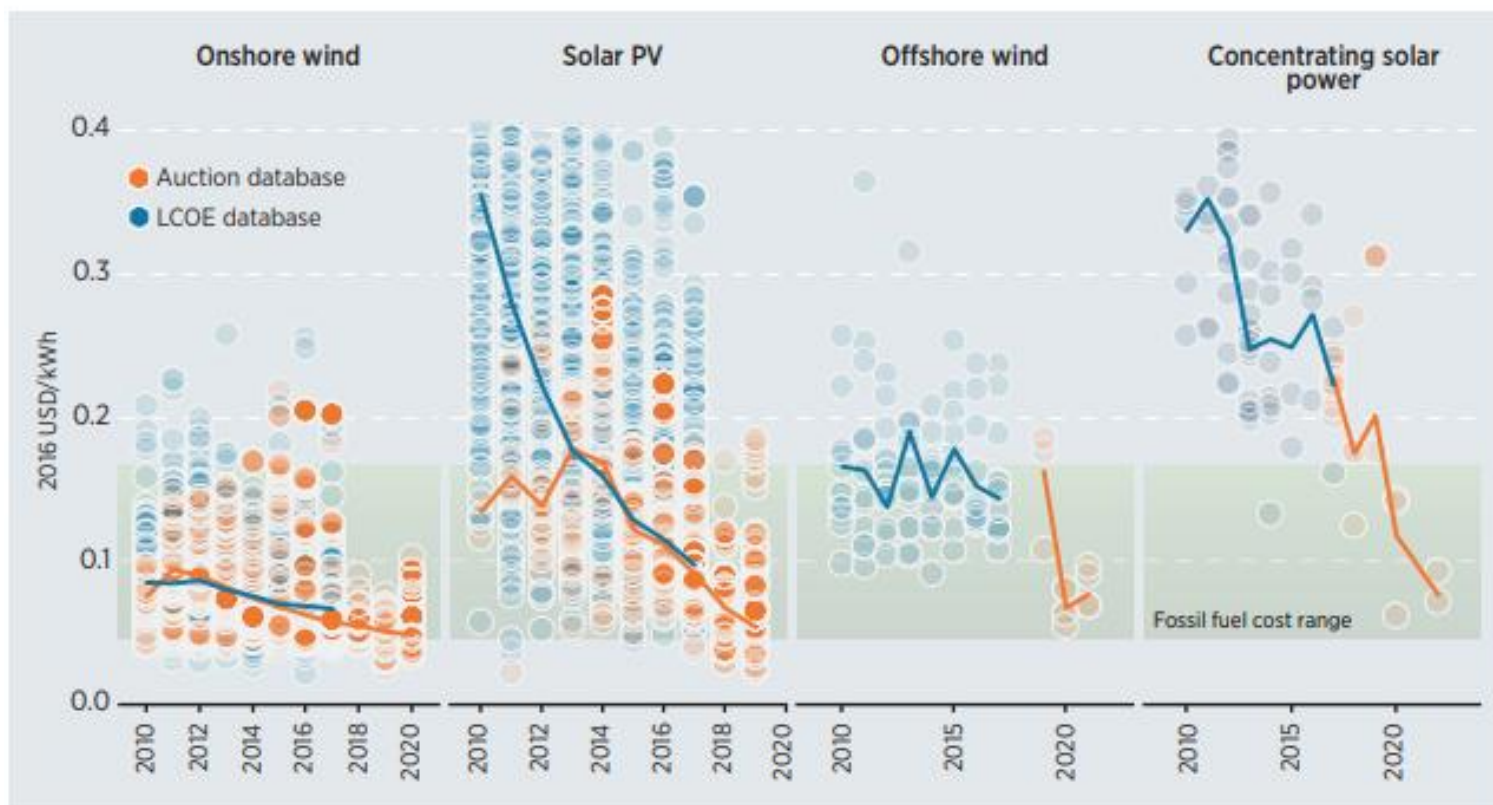


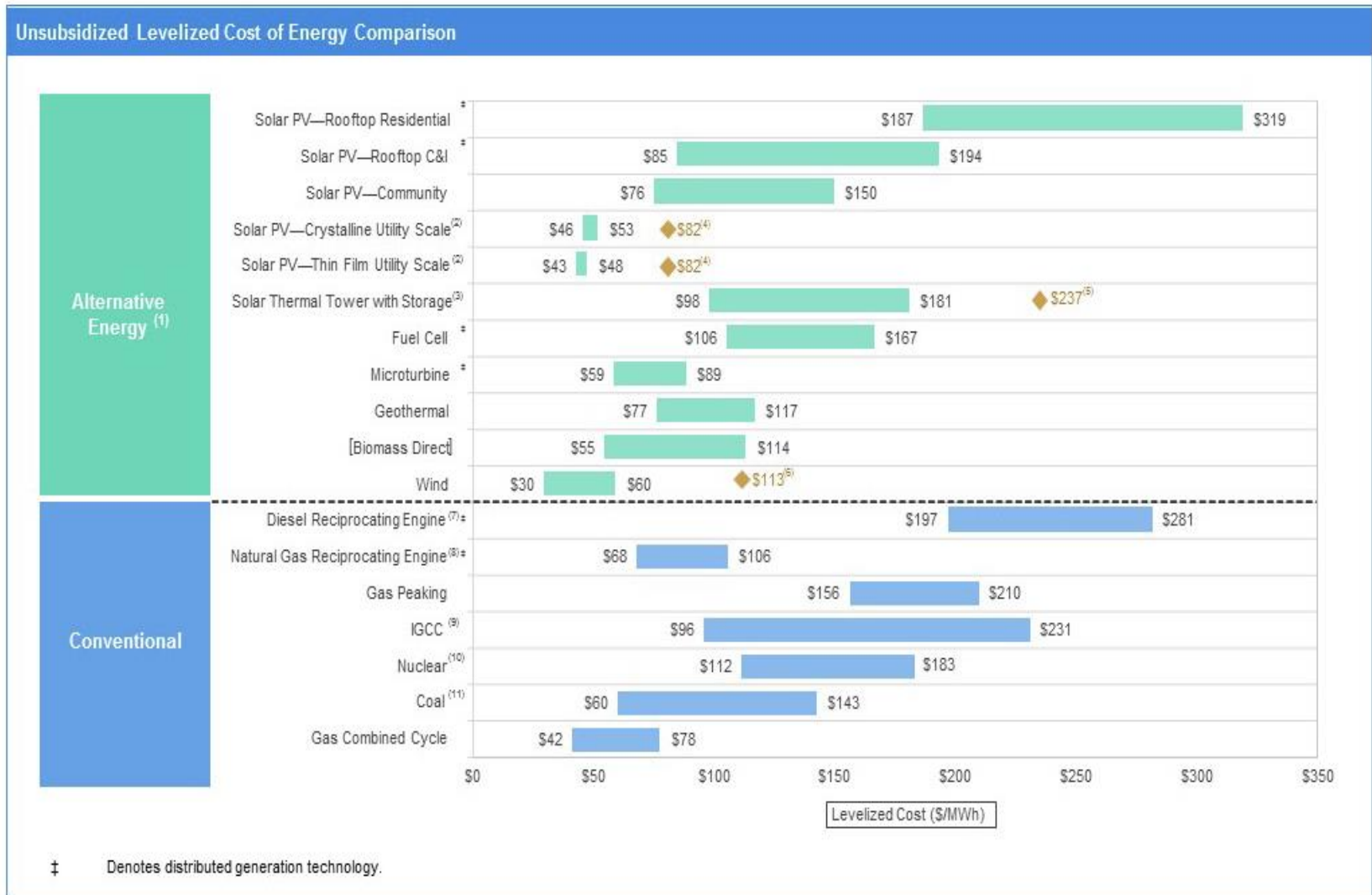
Figure ES.2 The levelised cost of electricity for projects and global weighted average values for CSP, solar PV, onshore and offshore wind, 2010-2022



Source: IRENA Renewable Cost Database and Auctions Database.

Note: Each circle represents an individual project or an auction result where there was a single clearing price at auction. The centre of the circle is the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE, or auction values, by year. For the LCOE data, the real WACC is 7.5% for OECD countries and China, and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

Lazard's latest annual Levelized Cost of Energy Analysis (LCOE 11.0) shows a continued decline in the cost of generating electricity from alternative energy technologies, especially utility-scale solar and wind.



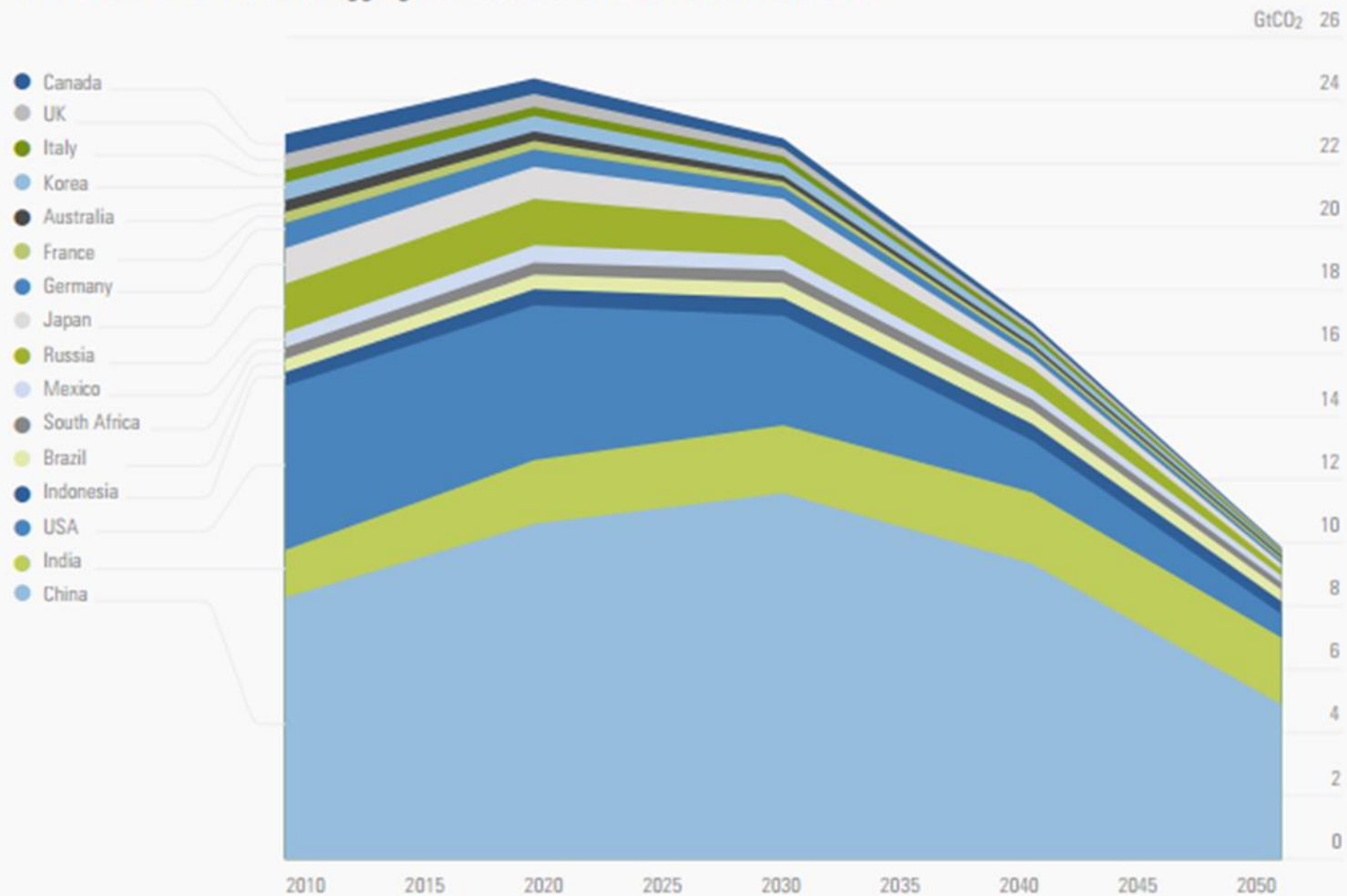
Paris Decision, Article 4 Par. 4

Developed country Parties shall continue taking the lead by undertaking economy-wide absolute emission reduction targets. **Developing** country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.

Paris Decision, Art. 4 Par. 1

In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, **so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century**, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

Figure 1. Emissions trajectories for energy CO₂, 2010-2050, showing most ambitious reduction scenarios for all DDPP countries. 2050 aggregate emissions are 57% below 2010 levels.



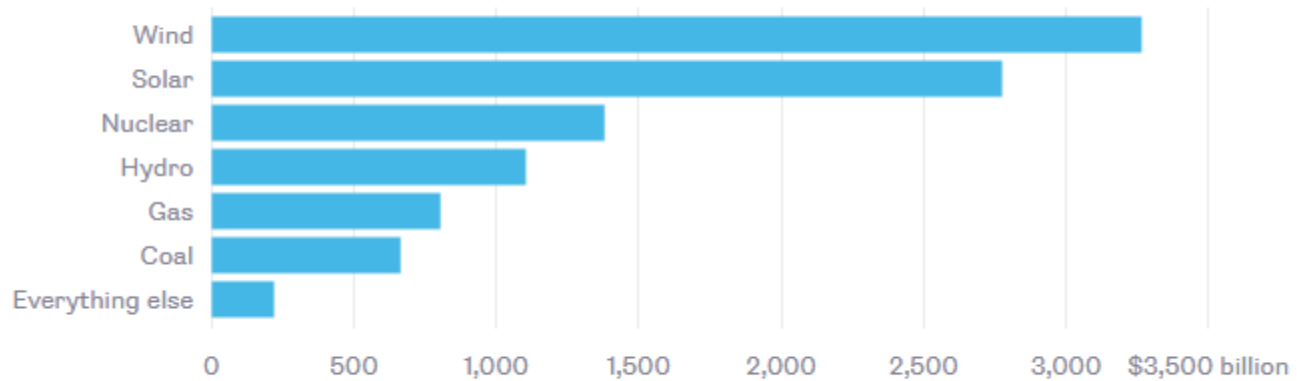
Development Opportunities in Climate Action

- Renewable energy
 - Industrial scale
 - Distributed generation
- Energy efficiency
 - Buildings/Materials
 - Cookstoves
- Carbon Markets
 - REDD+ , Article 6
 - ICAO
- Climate-related finance
 - Private sector
 - Green bonds
 - International financial institutions
 - International development assistance



Into the Trillions

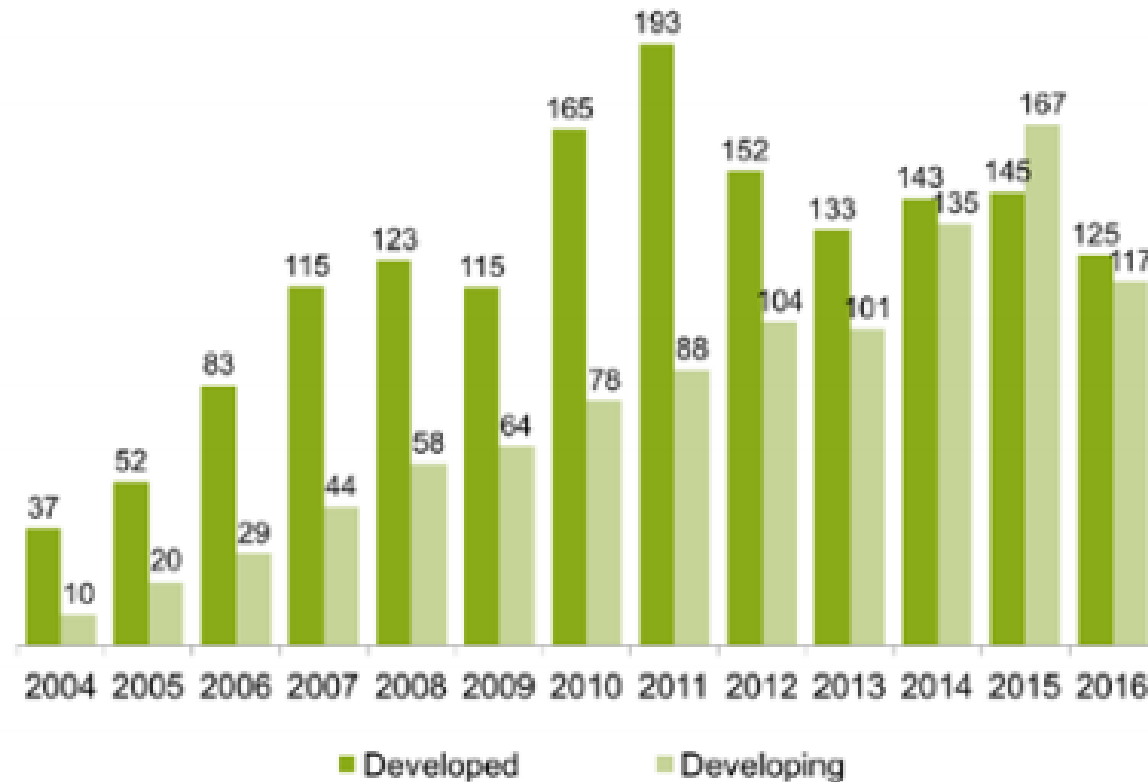
Investment in power generation technologies, 2017 to 2040



Source: Bloomberg New Energy Finance New Energy Outlook 2017

Note: "Everything else" includes geothermal, biomass and oil-fired power.

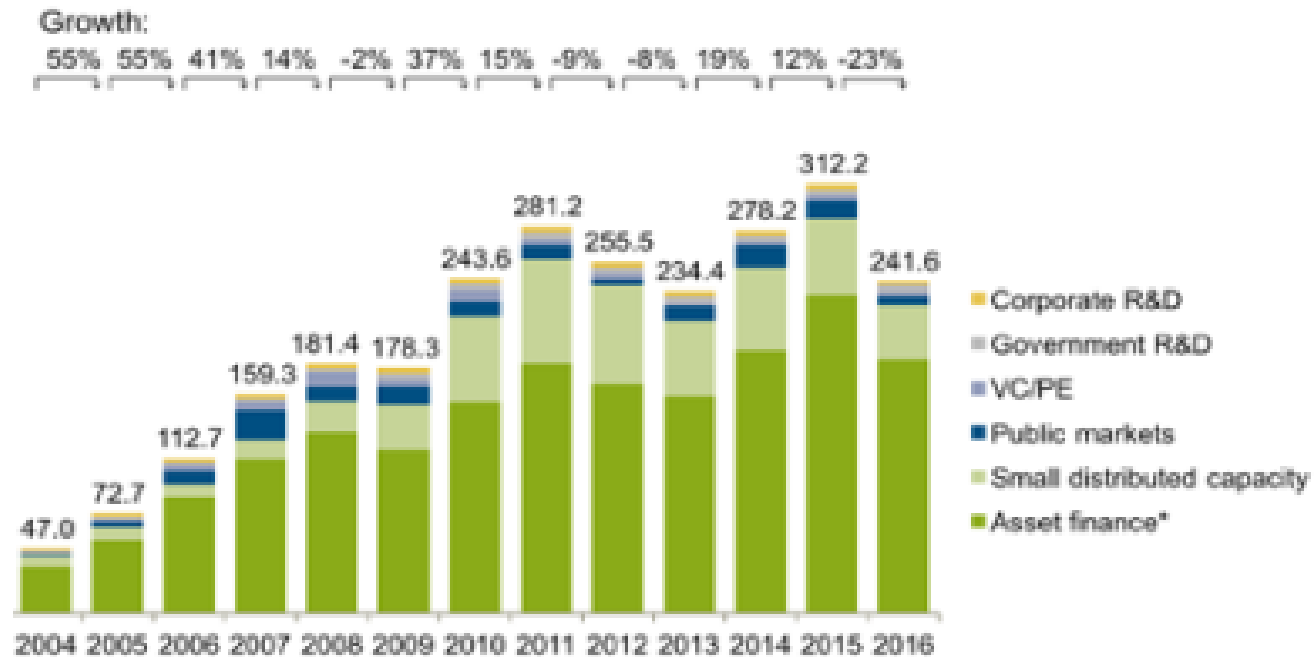
**FIGURE 4. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY:
DEVELOPED V DEVELOPING COUNTRIES, 2004-2016, \$BN**



New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Developed country volumes are based on OECD countries excluding Mexico, Chile, and Turkey

Source: UN Environment, Bloomberg New Energy Finance

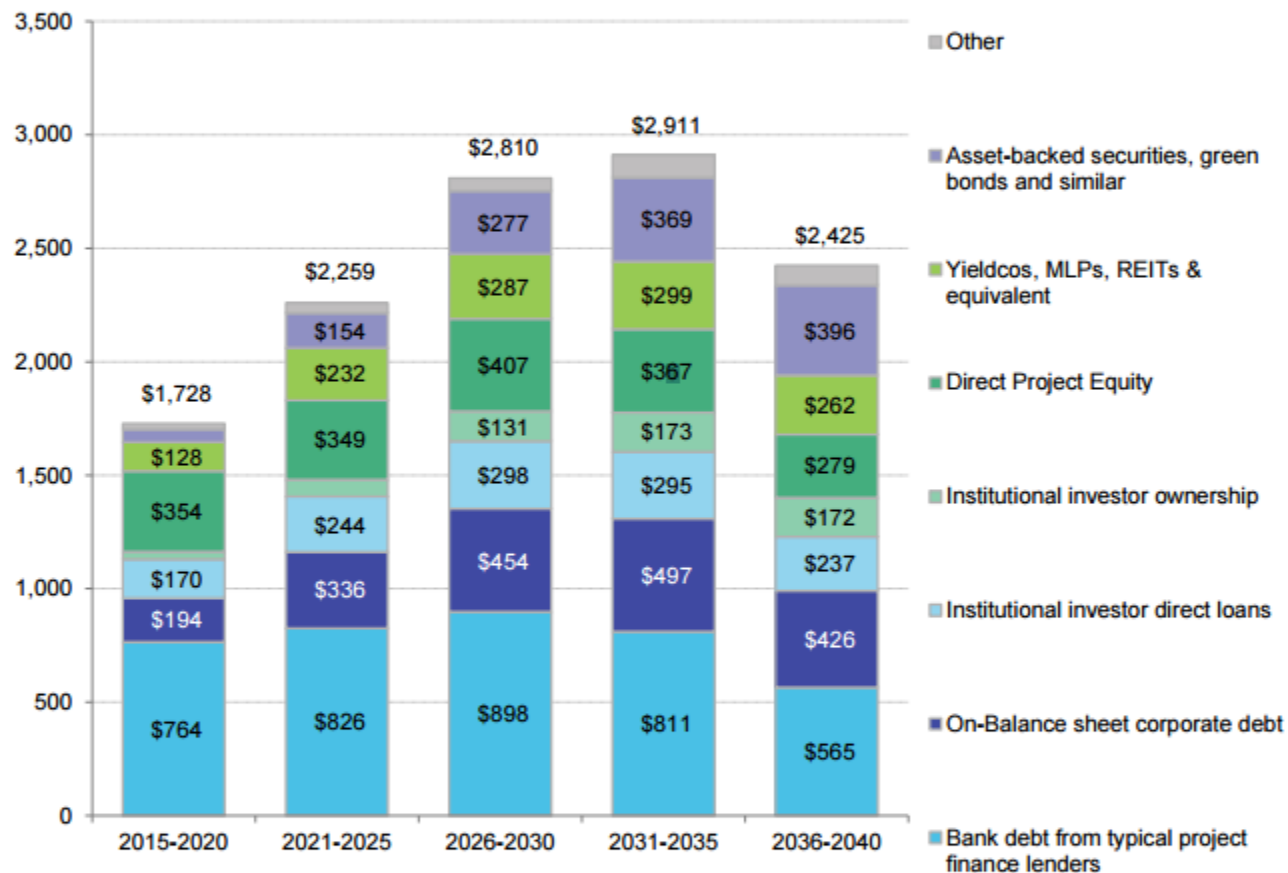
FIGURE 1. GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY ASSET CLASS, 2004-2016, \$BN



*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: UN Environment, Bloomberg New Energy Finance

POTENTIAL INVESTMENT IN NEW RENEWABLES BY ASSET CLASS, NEO 2°C SCENARIO (\$BN, REAL)



- To date, the vast majority of clean energy power generation debt has been financed through direct loans from project finance institutions, such as major banks.
- However, other industries raise similar or much larger volumes of capital in a wider diversity of ways. As perceptions of risk mature, similar results can be expected for new renewables.
- As clean energy continues to scale, the industry will expand the variety of sources of capital it taps to grow, with expanding investment opportunities in virtually every new renewable asset class.

The Problem for Investors

“Climate change is occurring. It has important implications for economic activity and therefore corporate performance. The effects of climate change are beginning to play out within and among industries and regions. They are likely to grow in significance in the years to come, becoming an increasingly important factor in the relative performance of firms, industries and investment portfolios.”



*CDSB Statement on Fiduciary Duty
and Climate Change Disclosure*

The Problem for Investors (cont.)

“... financial markets do not yet take sufficient account of climate-related corporate performance, risks and opportunities relevant to future shareholder value because of a lack of comprehensive and comparable information in ‘mainstream’ corporate reports for the investment community. This information gap undermines the efficiency by which markets are able to allocate capital to its most productive uses over the medium to long term....”

*CDSB Statement on Fiduciary Duty
and Climate Change Disclosure*

Climate Risk for Companies

- Regulatory Risk
- Litigation Risk
- Reputation Risk
- Transition Risk (and Opportunity)
- Climate Impacts Risk (and Opportunity)

Regulatory Risk

Current Laws and Regulations

- GHG emissions
- Natural resources management
 - Fossil fuel extraction
- Energy efficiency standards
- Securities and/or Blue Sky Laws

Regulatory Risk

Future Law and Regulation

- Carbon tax
- GHG emissions limits
- Cap-and-trade programs
- Fossil fuel bans
- Energy efficiency standards
- Process or product standards



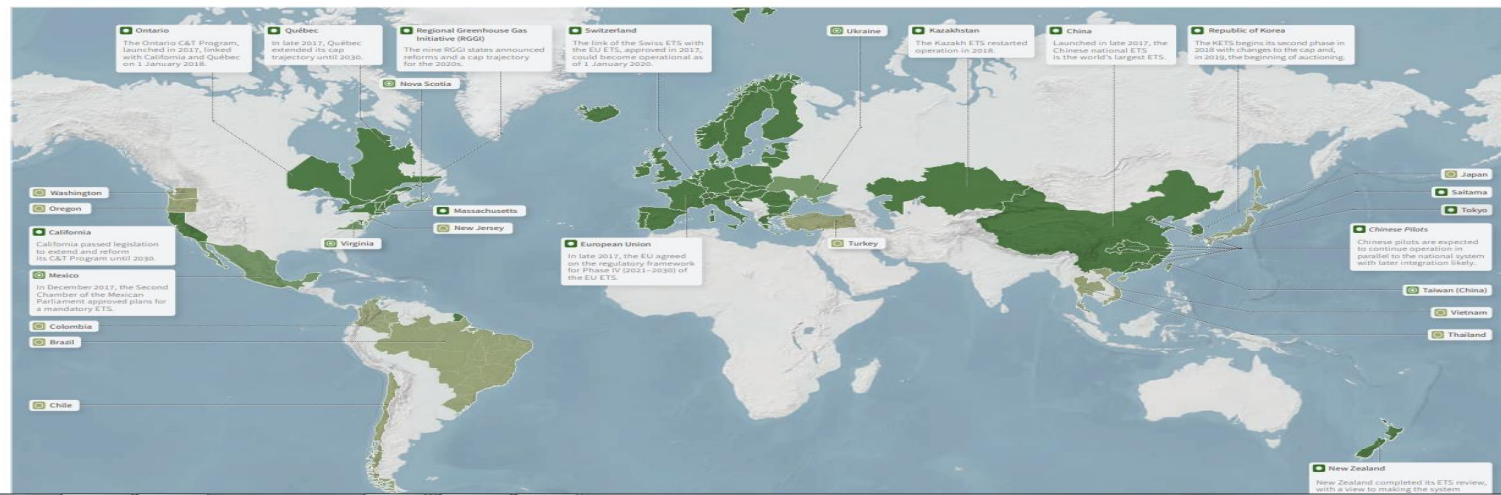
Emissions Trading Worldwide The state of play of cap-and-trade in 2018

The ICAP ETS world map depicts emissions trading systems currently in force, scheduled or under consideration. After China launched its national carbon market in late 2017, there are now 21 systems covering 28 jurisdictions in force. Another five jurisdictions—Mexico, Nova Scotia, Taiwan (China), Ukraine and Virginia—have an ETS officially scheduled. Finally, ten governments at different levels are considering the implementation of an ETS as part of their climate policy strategy, amongst them Colombia, Washington State and Thailand.

A regularly updated, interactive version of the ICAP ETS map with detailed information on all systems is available at:

www.icapcarbonaction.com

- ETS in force
- ETS scheduled
- ETS considered



Litigation Risk

Failure to disclose

- “Corporations and their management and directors are facing more risks in connection with climate change-related financial disclosures and the potential for shareholder and derivative suits based on alleged climate change-related financial nondisclosures.”
(Anderson, Kill & Olick, 2011)

Litigation Risk

Third Party Actions

- Failure to mitigate
 - Injunctions against business activities
 - Compensation for damages
- Failure to adapt
 - Injunctions to undertake adaptation
 - Compensation for damages

Transition Risk and Opportunity

- Impact on Business Prospects
- New Business Opportunities
- Stranded Assets
 - 2 degree stress test
 - Article 173 of French law on Energy Transition for Green Growth
 - Recent shareholder proposals in the US



Climate Impacts: Risk and Opportunity

- Climate Impacts
 - Changing weather patterns
 - Sea level rise
 - Shifts in species distribution
 - Changes in water availability
 - Changes in temperature
 - Variation in agricultural yield and growing seasons
- Impacts on Infrastructure and Real Property
- Impacts on Supply Chains
- Impacts on Operations
- Impacts on demands for services and products



Investor Strategies





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