Transformative Changes
Towards Climate Resilient and Sustainable Cities

4th International Forum on Low Carbon Cities

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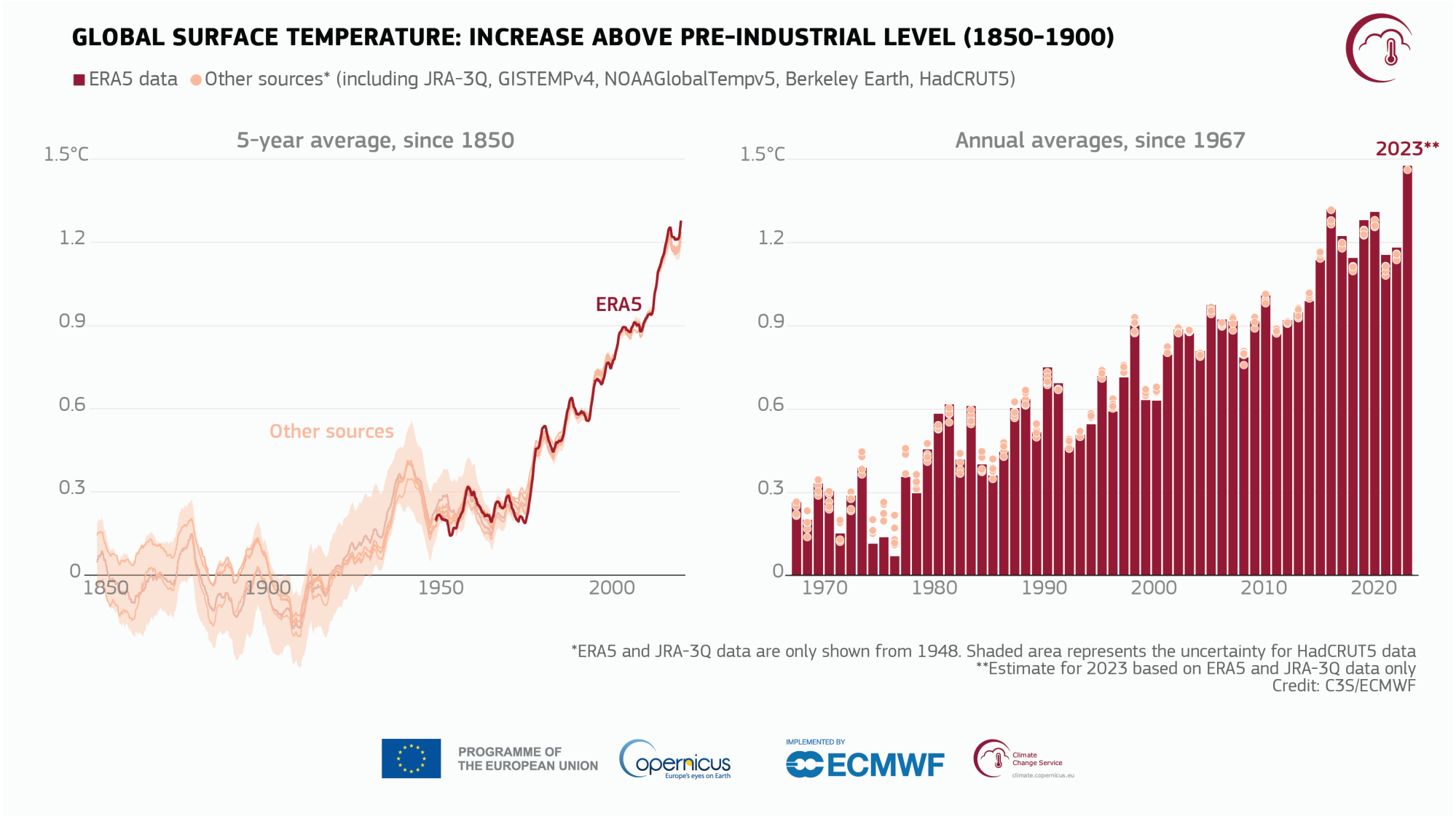
- Climate change is a serious threat to human well-being and planetary health.

- World moving towards 1.5℃ goal under the Paris Agreement

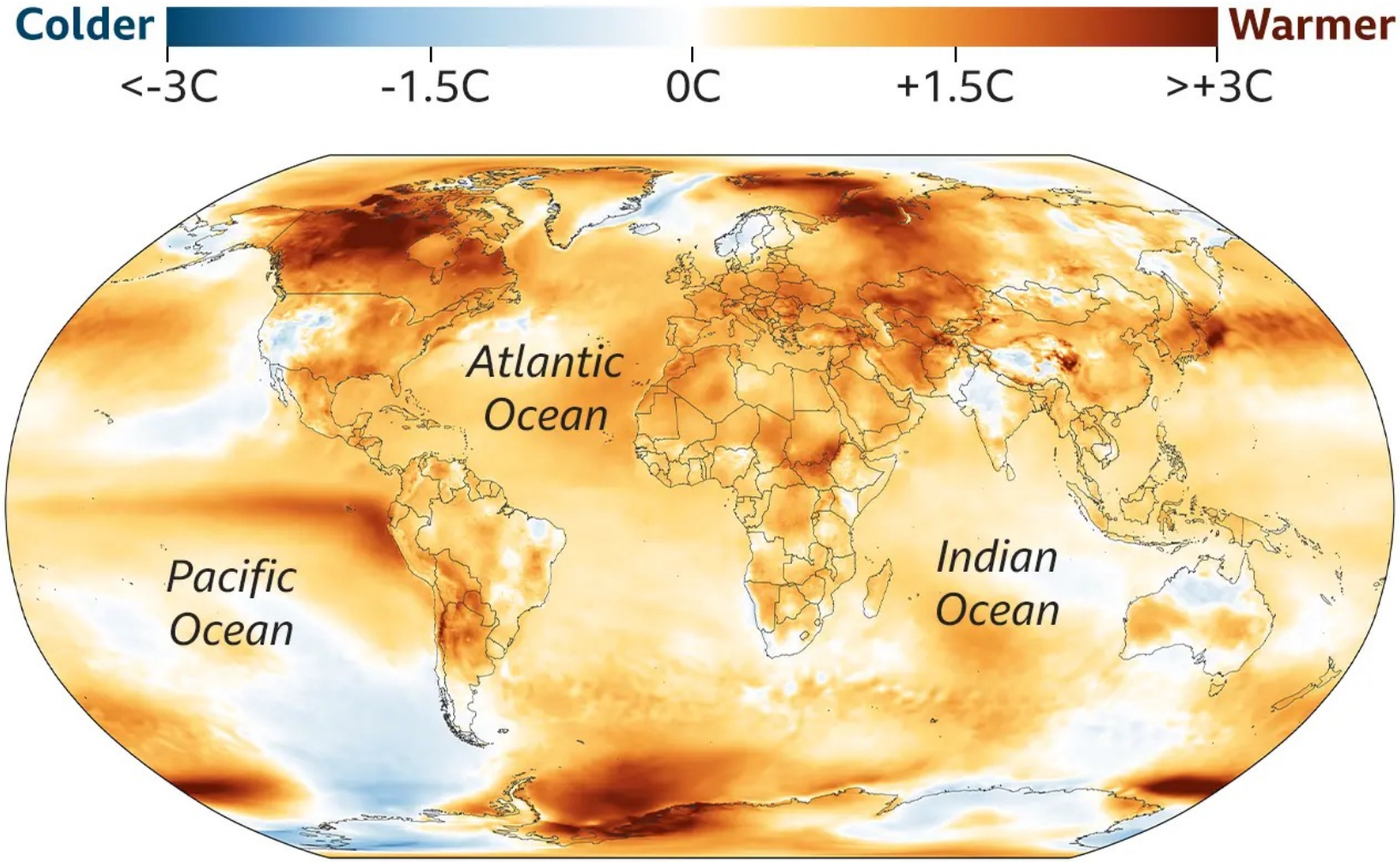
- Towards climate resilient and sustainable cities: Potentials and responsibilities of cities

The annual average global temperature was 1.45 ± 0.12 °C above pre-industrial levels (1850-1900) in 2023, according to WMO (Jan. 2024)



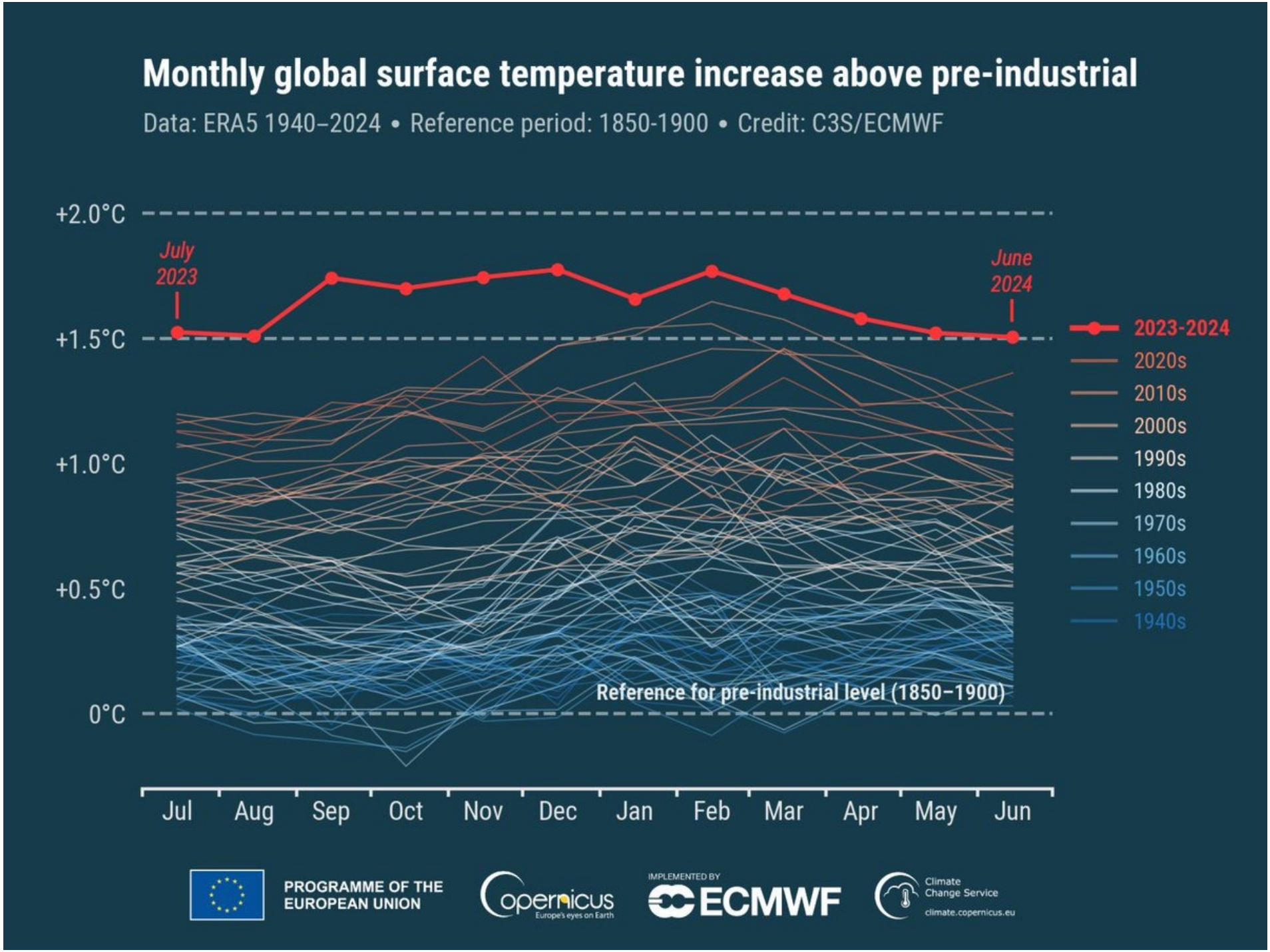
Most of the world much hotter than normal

Average surface air temperature in 2023 compared with 1991-2020 average



Source: ERA5, C3S/ECMWF

BBC


Monthly global surface temperature increase above pre-industrial
Data: ERA5 1940–2024 • Reference period: 1850-1900 • Credit: C3S/ECMWF
+2.0°C
+1.5°C
+1.0°C
+0.5°C
0°C
July 2023
June 2024
2023-2024
2020s
2010s
2000s
1990s
1980s
1970s
1960s
1950s
1940s
Reference for pre-industrial level (1850–1900)
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
PROGRAMME OF THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth
IMPLEMENTED BY
ECMWF
Climate Change Service
climate.copernicus.eu

2018 Top 10 Global Economic Loss Events

Date (s)	Event	Location	Deaths	Economic Loss（billion USD）	Insured Loss（billion USD）
October 10-12	Hurricane Michael	US	32	17.0	10.0
September 13-18	Hurricane Florence	US	53	15.0	5.3
November	Camp Fire	US	88	15.0	12.0
September 4-5	Typhoon Jebi (No. 21)	Japan	17	13.0	8.5
July 2-8	Flooding	Japan	246	10.0	2.7
Spring & Summer	Drought	Central & Northern Europe	N/A	9.0	0.3
September 10-18	Typhoon Mangkhut	Oceania, East Asia	161	6.0	1.3
July - September	Flooding	China	89	5.8	0.4
November	Woolsey Fire	US	3	5.8	4.5
August 16-19	Tropical Storm Rumbia	China	53	5.4	0.3
	All Other Events		-	123.0	45
		Totals		225.0	90.0

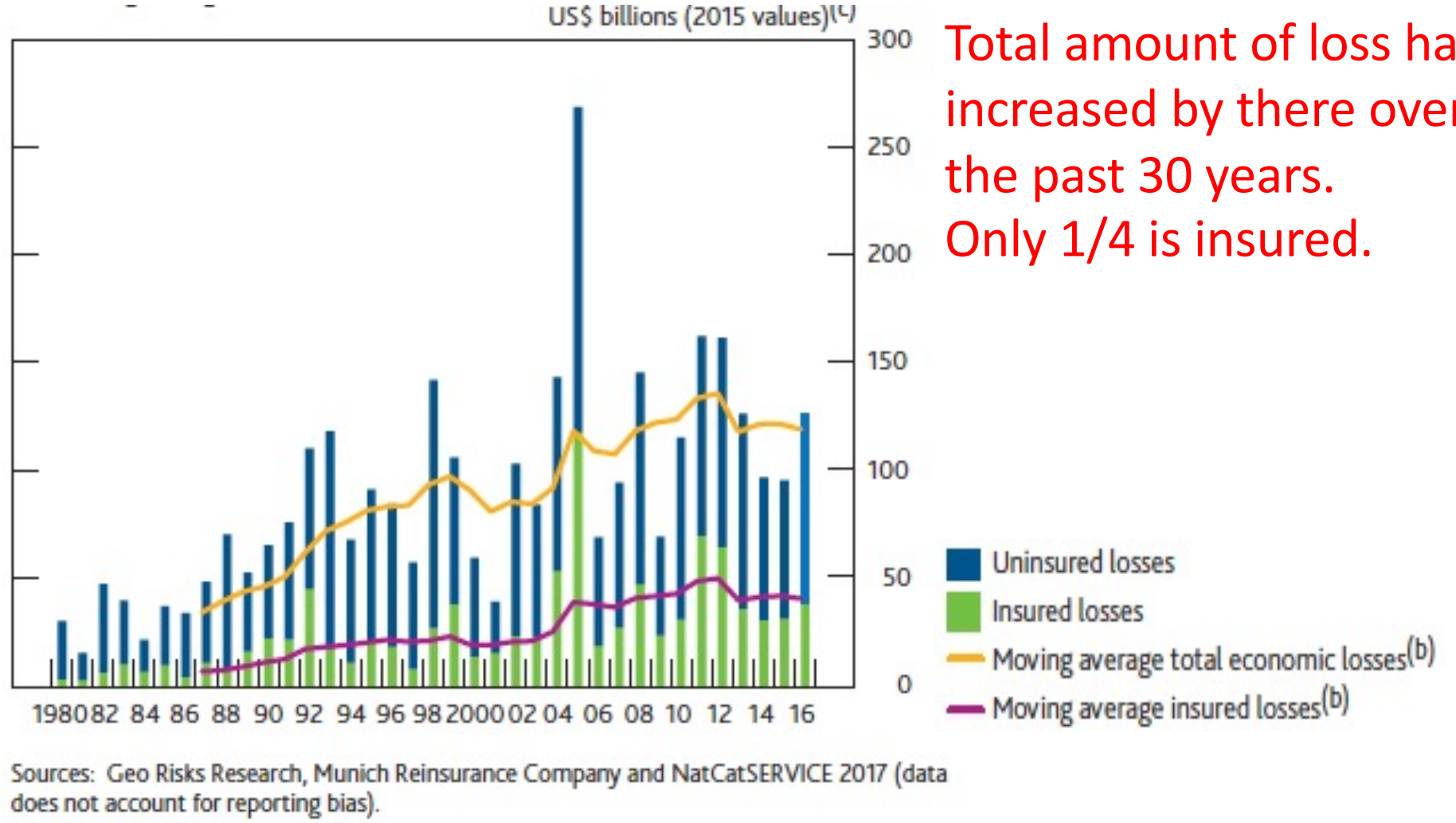
Source：AON, 2019

2019 Top 10 Global Economic Loss Events

Date (s)	Event	Location	Deaths	Economic Loss（USD billions）	Insured Loss（USD billions）
October 6-12	Typhoon Hagibis (No. 19)	Japan	99	15.0	9.0
June - August	Monsoon Floods	China	300	15.0	0.7
September 7-9	Typhoon Faxai（No. 15）	Japan	3	10.0	6.0
May - July	Mississippi Basin Floods	United States	0	10.0	4.0
August 25 – Sep 7	Hurricane Dorian	Bahamas, Caribbean, US, Canada	83	10.0	3.5
March 12-31	Missouri Basin Floods	United States	10	10.0	2.5
June - October	Monsoon Floods	India	1750	10.0	0.2
August 6-13	Typhoon Lekima	China, Philippines, Japan	101	9.5	0.8
March - April	Flooding	Iran	77	8.3	0.2
May 2-5	Cyclone Fani	India, Bangladesh	81	8.1	0.5
		All Other Events		126 billion	44 billion
		Totals		232 billion	71 billion

Source：AON, 2020

Global Climate related Economic Loss Trends（1980-2016）



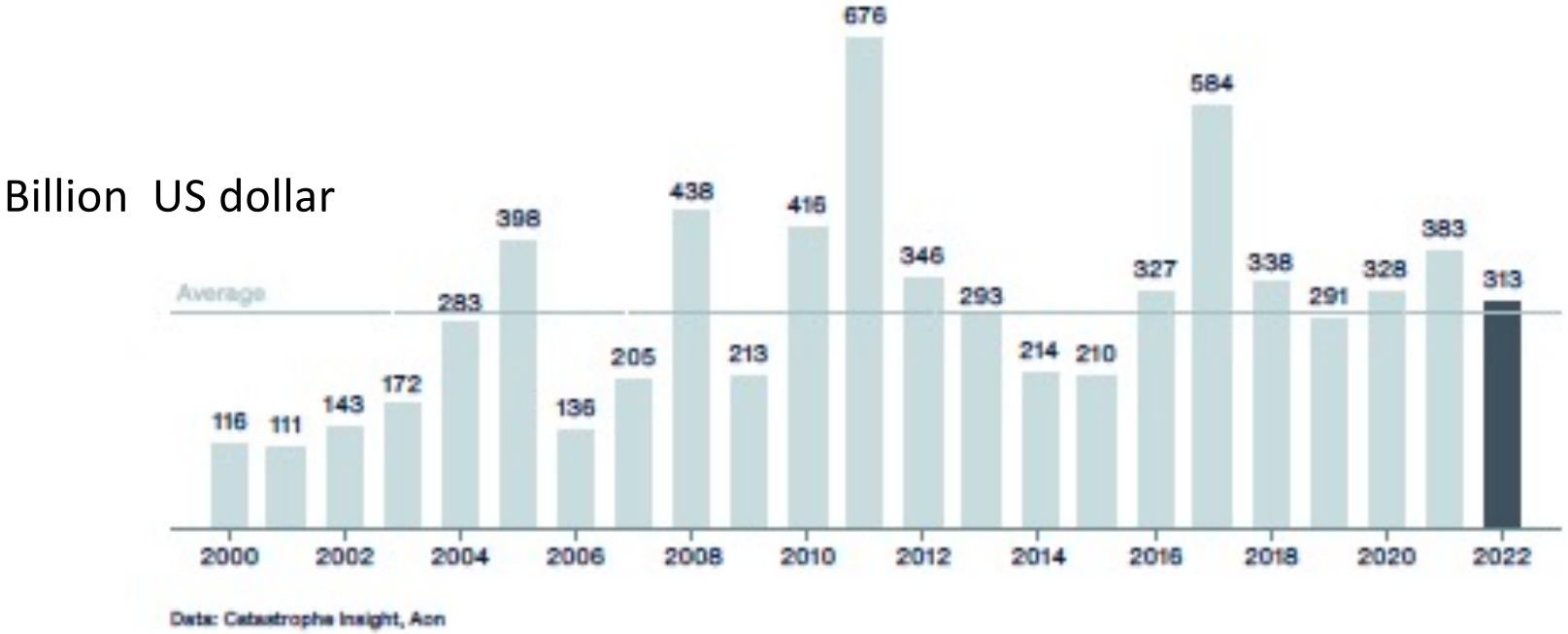
Total amount of loss has increased by there over the past 30 years.
Only 1/4 is insured.

Source：Bank of England, Quarterly Bulletin 2017 Q2, 2017

Global economic losses from natural disasters (since 2000)

Global economic losses in 2022 = 313 billion US dollars in 2022, close to the 21st century average.

Losses from weather related disasters were 17% above the average since 2000.



Source : AON, 2023

2022 Top 10 Human fatality events

			Deaths	Economic loss ($ billion)
10-20 July	Heatwave	Western, Southern and Central Europe	15450	N/A
13 – 19 June	Heatwave	Western, Southern and Central Europe	3750	N/A
17 May -31 October	India Seasonal Floods	India	2135	4.2
14 June -30 October	Pakistan Seasonal Floods	Pakistan	1739	15.0
22 June	Earthquake	Afghanistan, Pakistan	1163	0.1
1 July -31 October	Nigeria Seasonal Floods	Nigeria	660	2.3
21 November	Cianjur Earthquakes	Indonesia	603	0.4
8 -15 April	KwaZulu-Natal Floods	South Africa	455	3.6
15-16 February	Rio de Janeiro Floods	Brazil	232	＜0.1
8-13 April	Tropical Storm Megi	Philippines	214	＜0.1
	All other events		4900	287.0
		Totals	31300	313 billion

Source：AON, 2023

Projected changes in extremes are larger in frequency and intensity

1850-1900		Present 1°C	1.5°C	2°C	4°C
Hot temperature extremes over land: 10-year event	Intensity increase	1.2°C hotter	1.9°C hotter	2.6°C hotter	5.1°C hotter
	Frequency per 10 years	2.8 times	4.1 times	5.6 times	9.4 times
Hot temperature extremes over land: 50-year event	Intensity increase	1.2°C hotter	2.0°C hotter	2.7°C hotter	5.3°C hotter
	Frequency per 50 years	4.8 times	8.6 times	13.9 times	39.2 times
Heavy precipitation over land: 10-year event	Intensity increase	6.7% wetter	10.5% wetter	14.0% wetter	30.2% wetter
	Frequency per 10 years	1.3 times	1.5 times	1.7 times	2.7 times
Agricultural & ecological droughts in drying regions: 10 year event	Frequency per 10 years	1.7 times	2.0 times	2.4 times	4.1times

Source: IPCC AR6, 2021

Climate impacts affecting cities (1)

- More frequent extreme weather events
  - Cities are experiencing increased exposure to extreme weather events such as floods and storms, resulting in loss of lives and livelihoods, displacement of people and damage to infrastructure.
- Sea level rise and increased flood risk
  - Coastal cities are especially vulnerable to sea level rise with a sizable population.
  - Projections with BAU scenario indicate heightened flood risks for hundreds of densely populated coastal urban areas by mid-century.
  - Many low-lying regions along the coasts of Latin America, Africa, and Southeast Asia may face a severe threat of permanent inundation in the middle of this century.
  - By 2100, climate change is expected to cause the submergence of a significant share of land (>5 percent) in the Small Island Developing States (SIDS).

Climate impacts affecting cities (2)

- Heatwaves and air pollution
  - The “urban heat island effect" intensifies heatwaves and can lead to temperatures that are much higher than those in rural areas.
  - With rapid urbanization, the urban heat island effect could mean that cities are warming at twice the global average rate, potentially increasing temperatures by up to 4°C if GHG emissions remain on their current trajectory.
  - Heatwaves worsen air quality in cities and pose specific health risks to urban areas, exacerbating climate impacts by increasing carbon emissions from ground-level ozone formation.

Climate impacts affecting cities (3)

- Threats to food and water
  - Cities are responsible for about 75 percent of global natural resource consumption.
  - Variability and disruptions to the systems that provide reliable, high quality and affordable sources of food and water, can have enormous impacts on life of population in cities.
- Increased inequalities and disparities
  - Climate impacts tend to increase existing social and economic disparities, especially in developing countries where cities are tackling a surge in rural-to-urban migration, often fueled by displacement from climate impacts, leading to growing population with climate-related vulnerabilities, compounded by limited access to essential services.

IPCC Sixth Assessment Report（impacts, Adaptation and Vulnerability）（Feb. 2022）

- *The cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all.*

- 「気候変動は人類の福利と地球の健全さの脅威である一これまで積み上げられた科学的証拠は明白である。すべての人が普通に生活できる持続可能な未来を確かなものとする可能性は私たちの目前で急速に小さくなっているが、世界が協力して排出削減策と適応策を先駆けてとることをこれ以上遅らせるならば、その限られた可能性を失うこととなろう」

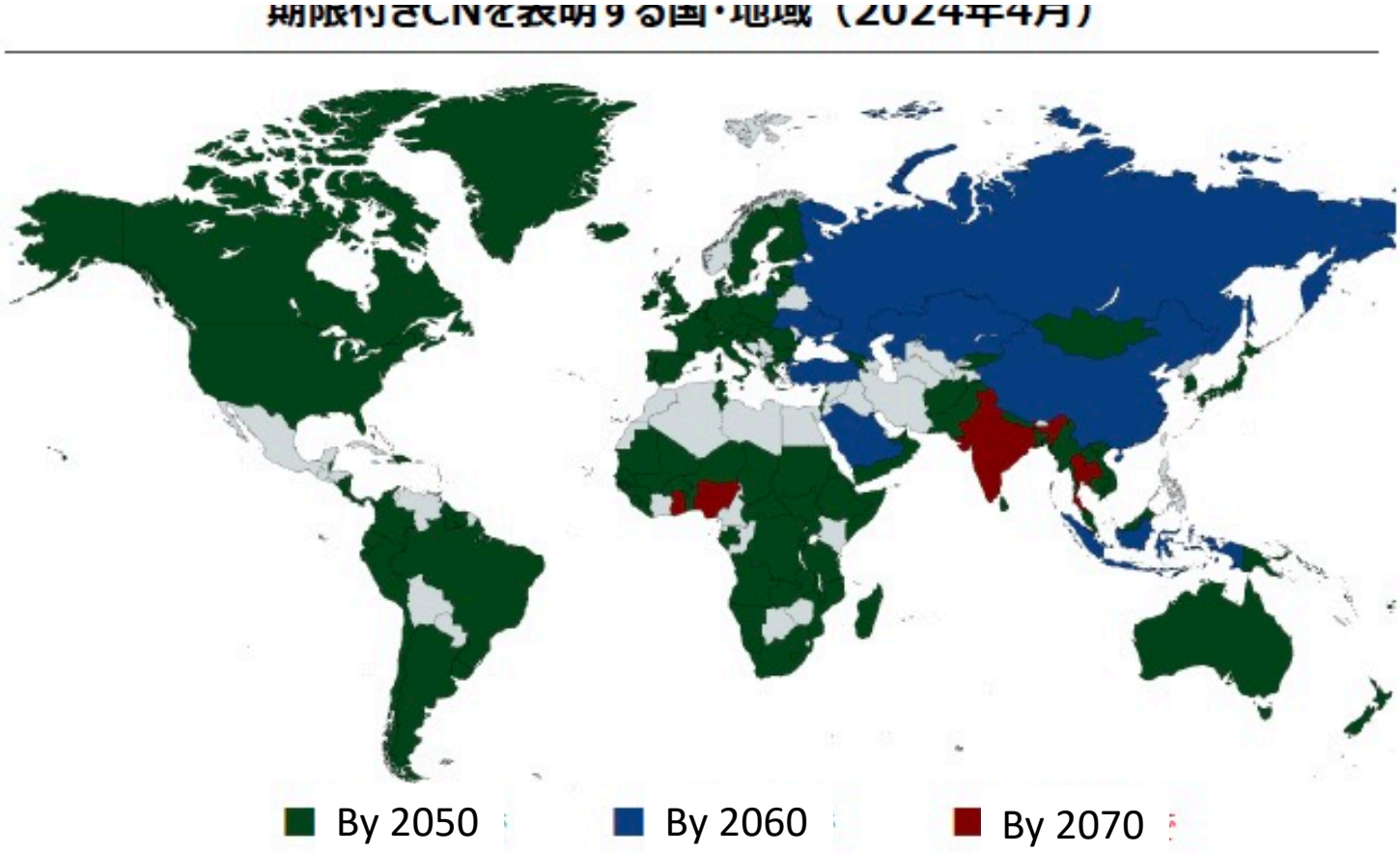
Towards climate neutrality (net zero) by 2050

- Paris Agreement (2015)
  - Holding the increase in the global average temperature to well below 2 ℃ and pursuing efforts to limit the temperature increase to 1.5 ℃ above pre-industrial levels (Art. 2.1 (a))
  - “Net zero emission” “De-carbonization” in the second half of this century (Art. 4.1)

- More than 140 countries and EU including all G7 countries have now pledge to reduce emission to net zero by 2050 at the latest.
  - Japan declared that “Japan pledges to, by 2050, reduce GHG emission in Japan to net zero, namely become carbon neutral and achieve a decarbonized society”.

- At COP26 in Glasgow, countries agreed to "resolves to pursue efforts to limit the temperature increase to 1.5℃".

More than 140 countries pledge net zero goal (as of April 2024)



（出典）各国政府HP、UNFCCC NDC Registry、Long term strategies、World Bank database等を基に作成
※グテーレス国連事務総長等の要求により、COP25時にチリが立ち上げた2050年CNに向けて取り組む国・企業の枠組みである気候野心同盟（Climate Ambition Alliance）に参加する国を含む場合、163ヵ国。

Source: Ministry of Economy, Industry and Trade, Japan 2024

Implications of Paris long-term goal

- The PA defines a clear long-term goal towards de-carbonization that international community aims to achieve.
  - "Holding the increase in the global average temperature to well below 2 ℃ and pursuing efforts to limit the temperature increase to 1.5 ℃ above pre-industrial levels" (Art. 2.1)
  - "Net zero emission" "De-carbonization" "climate neutrality" in the second half of this century (Art. 4.1)
  - COP26 (2021) : "resolve to pursue efforts to limit the temperature increase to 1.5℃"

- Climate science has provided enhanced justification of Paris long-term goal.
  - Climate Science, including event attribution, showing evidence that adverse impacts of climate change have already been occurring.
  - Prediction shows more increase in temperature will lead to larger changes.
  - Unequitable distribution of adverse impacts and risks of climate change: the most vulnerable countries and population would face more severely. "climate justice". "No one left behind"

The most recent science tells us

IPCC Sixth Assessment Report Synthesis Report （March 2023）

- Critical decade/decisive decade
  - Climate change as imminent risk. Global climate related economic loss has inreased.
  - Every increment of global warming will intensify multiple and concurrent hazards. "Limits to adaptation"
  - 1.5℃ and 2℃ goals involve rapid and deep, immediate GHG emissions reductions in all sectors this decade. Global net zero CO2 emissions are reached in the early 2050s, and around the early 2070s, respectively.

		Reduction rate compared to emissions in 2019			
		2030	2035	2040	2050
1.5℃ goal （>50%）	GHG	43 [34 - 60]	60 [49 - 77]	69 [58 - 90]	84 [73 - 98]
	CO2	48 [36 - 69]	65 [50 - 96]	80 [61 - 109]	99 [79 - 119]
2℃ goal （>67%）	GHG	21 [1 - 42]	35 [22 - 55]	46 [34 - 63]	64 [53 - 77]
	CO2	22 [1 - 44]	37 [21 - 59]	51 [36 - 70]	73 [55 - 90]

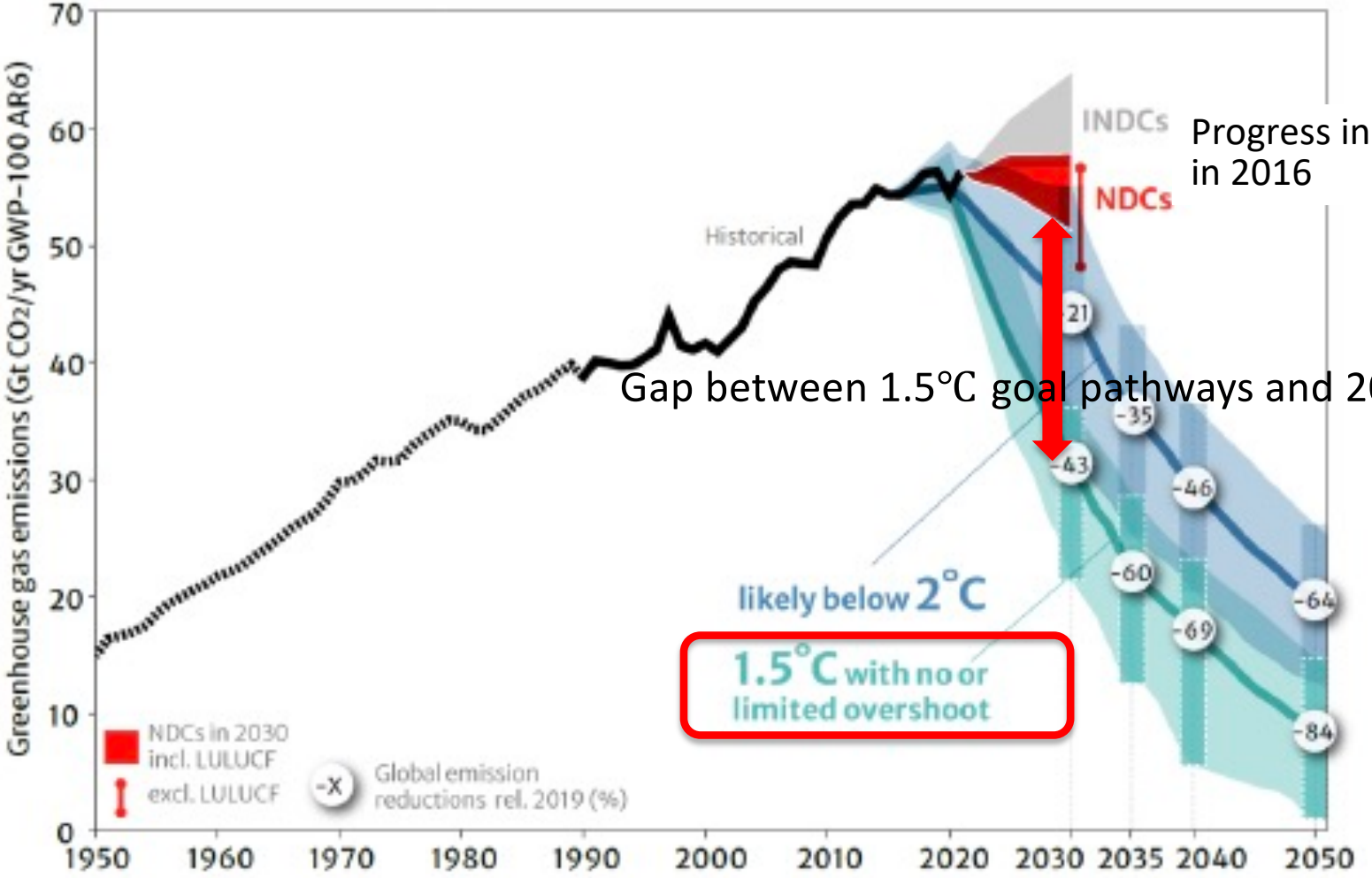
- From goals and policies to implementation and actions
- Extension of our present society will not lead to a sustainable society in future.

= need "systems transitions"

Source：IPCC, 2023, modified by Takamura

Gap between pathways toward 1.5°C goal and 2030 NDCs

Extension of our present society will not lead to a sustainable society in future.
= need "systems transitions"
Clear long-term vision/goal for future society makes us identify and understand challenges.



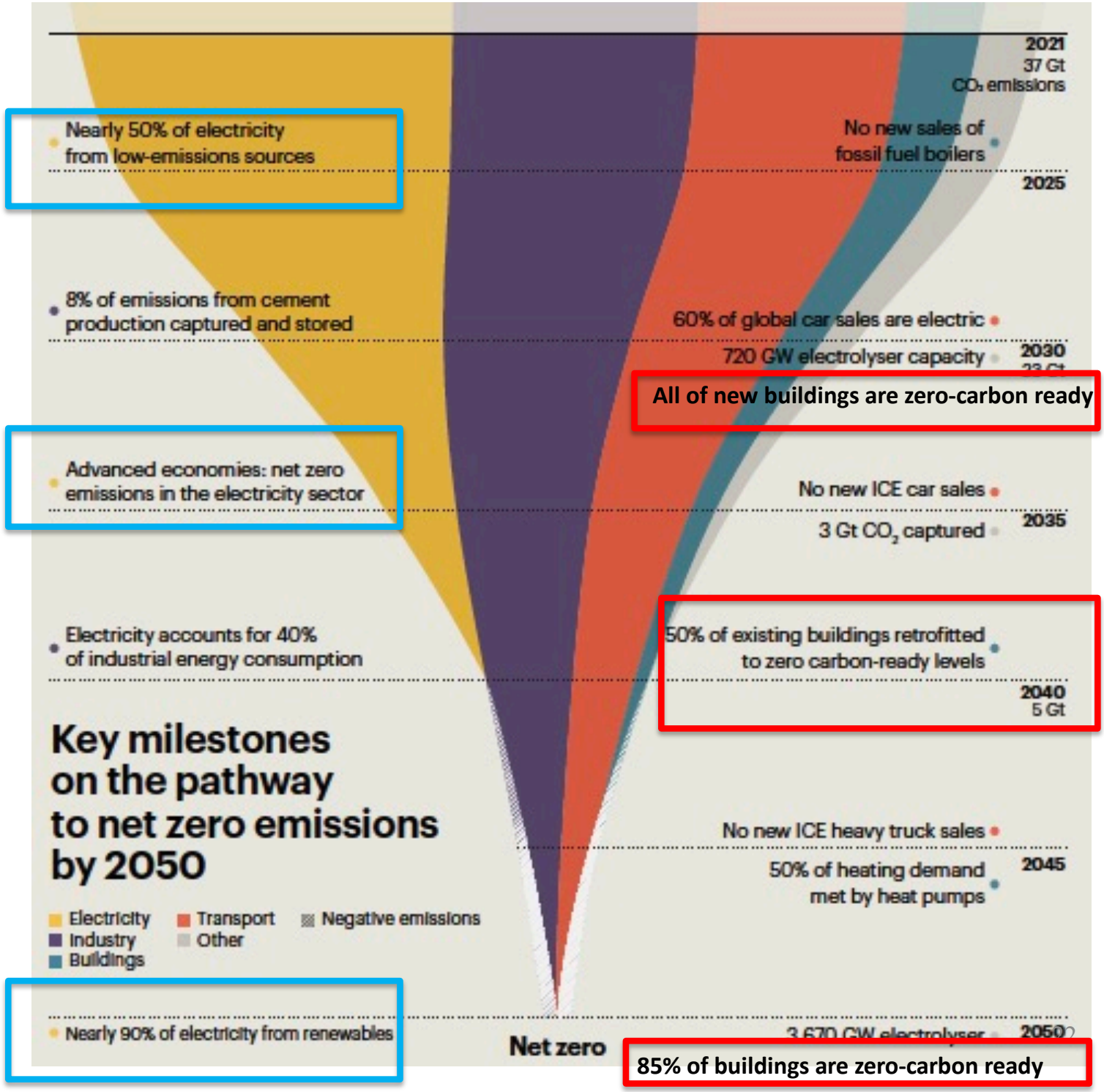
Source：UNFCCC 2023

Pathways towards 1.5℃ goal need systems transitions unprecedented in terms of scale

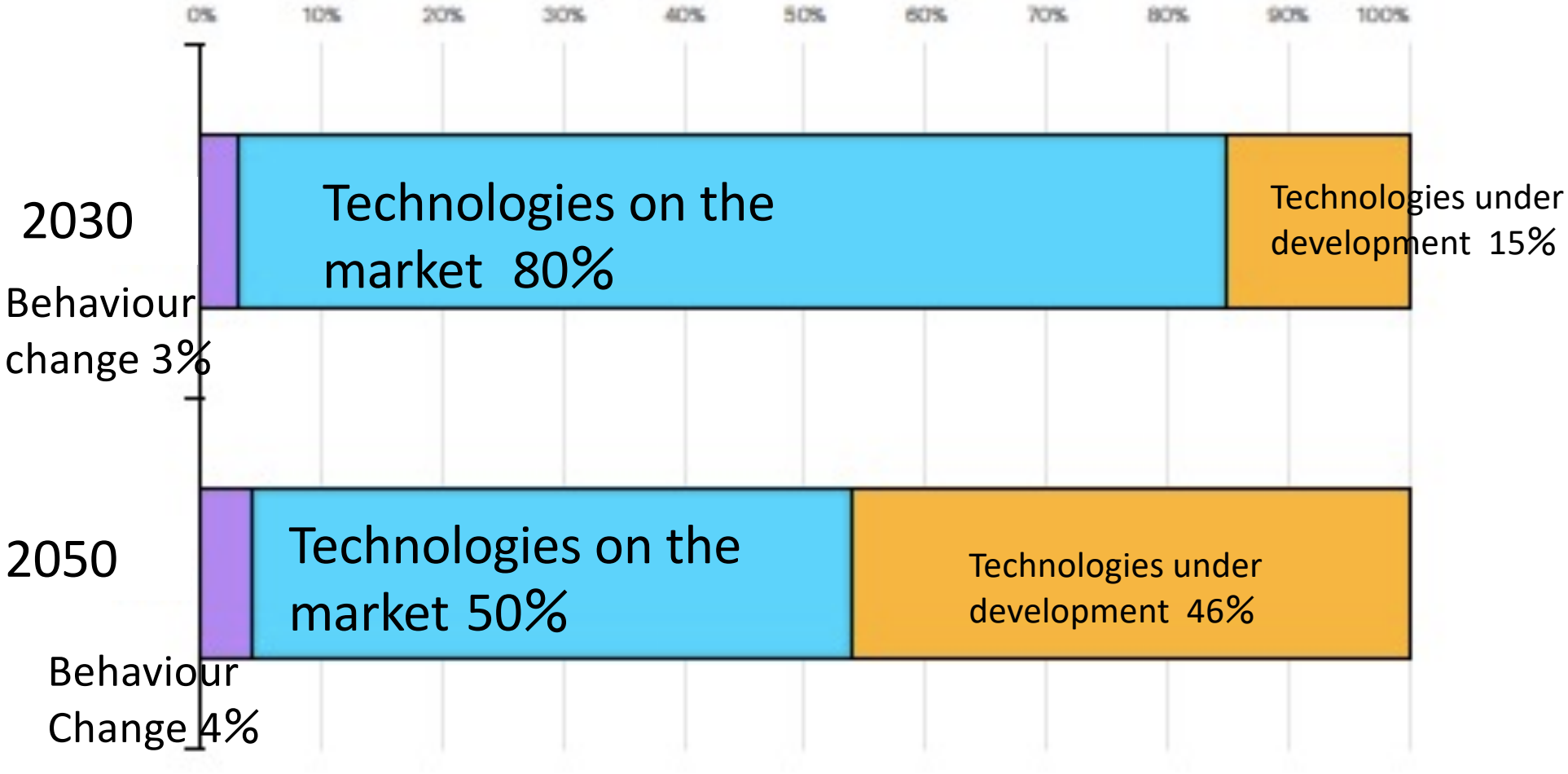
- "Pathways limiting global warming to 1.5 ℃ with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems. These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options."

Source: IPCC, 2018

Source : IEA 2022



How we could fill the gaps in 2030 and 2050

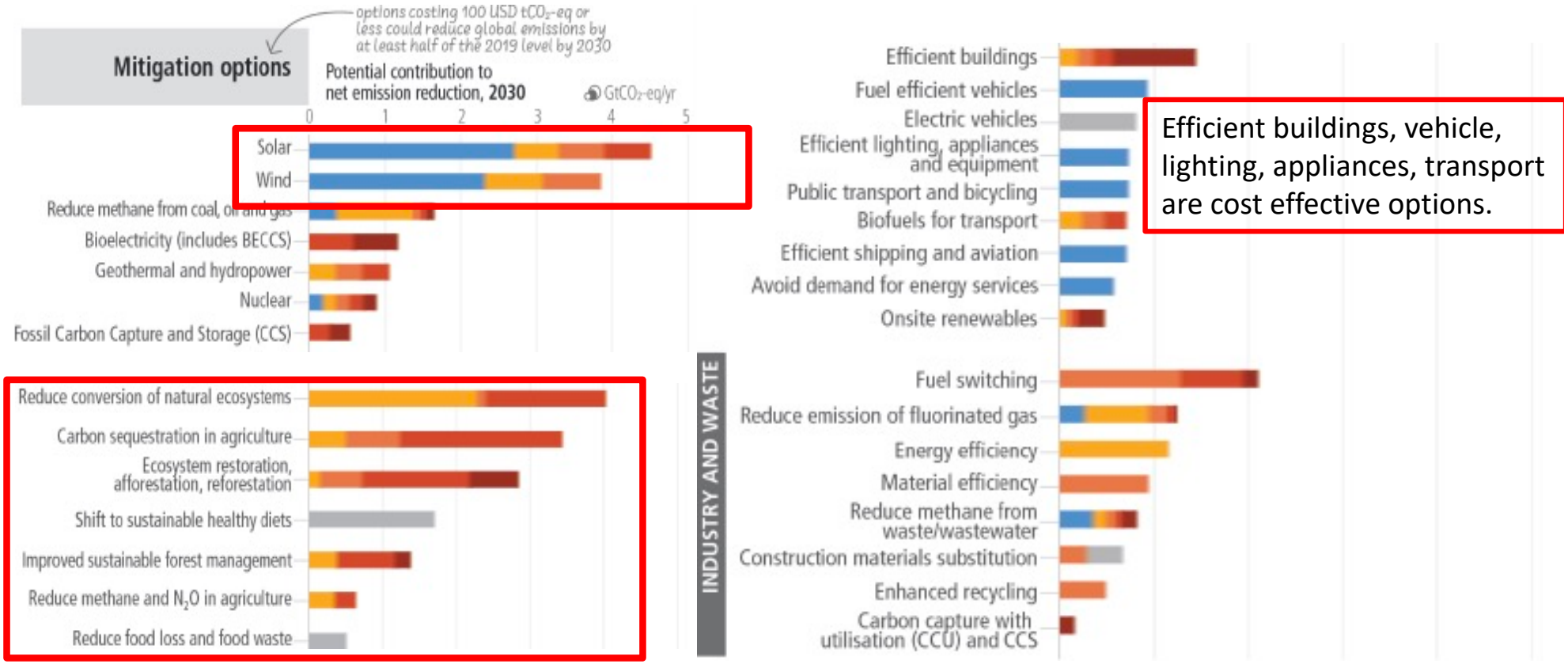


Source：IEA、2021

Cost effective mitigation options are available

Energy Supply

Infrastructure



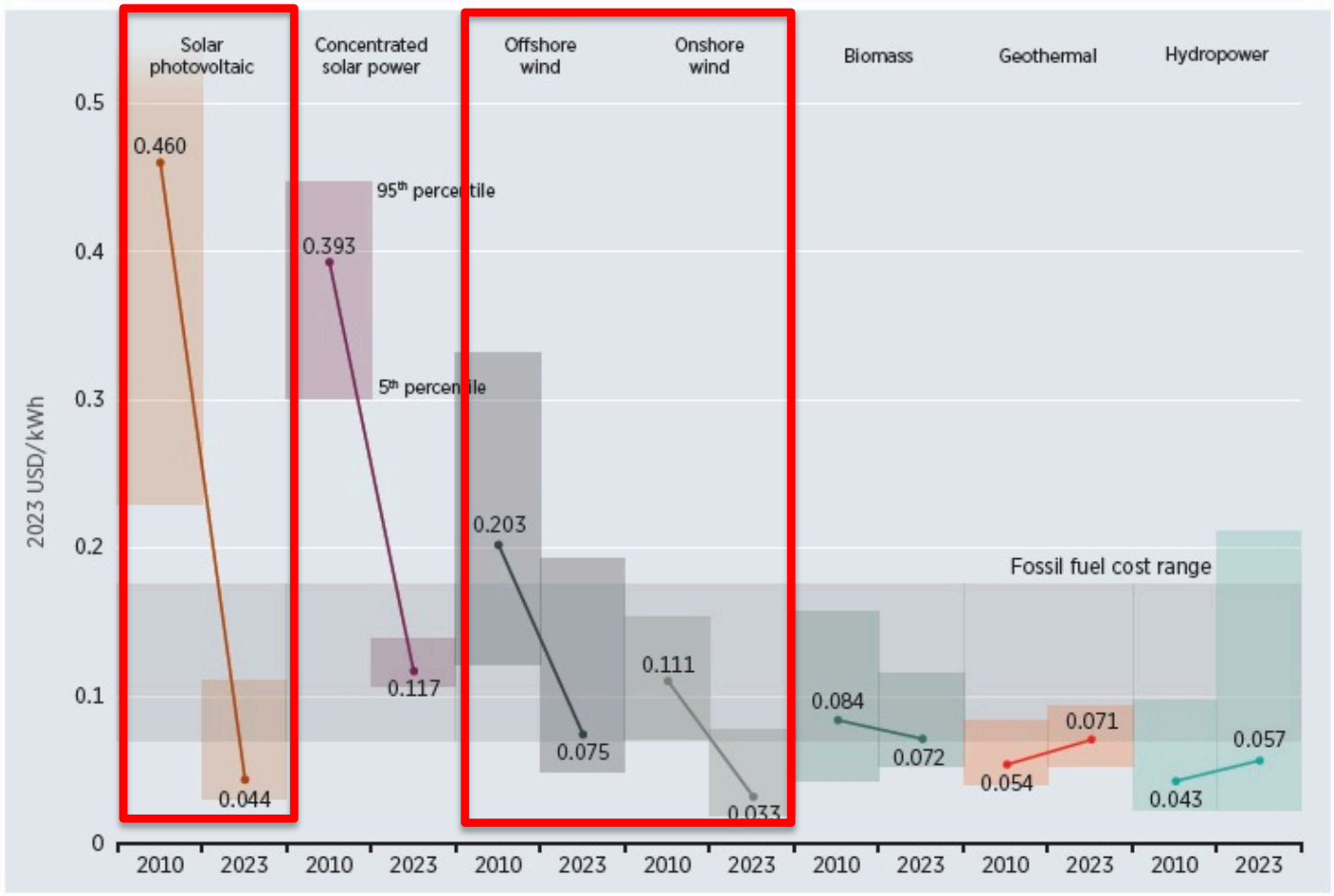
Efficient buildings, vehicle, lighting, appliances, transport are cost effective options.

Land, Water, Food

Source: IPCC AR6 Synthesis Report、2023

Cost of renewables declines(2010 – 2023)

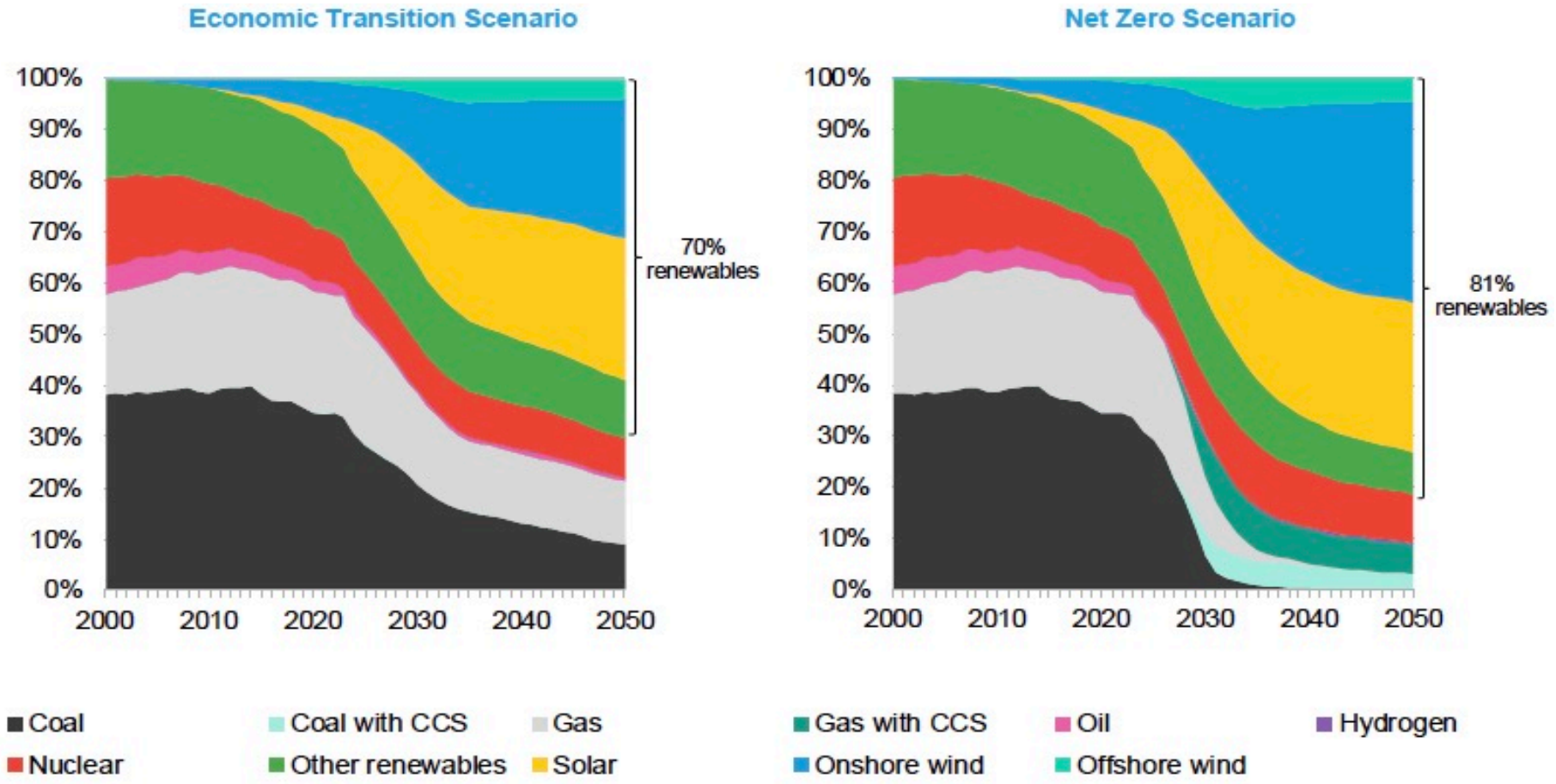
Cost of solar has been reduced by 90% over 13 years while onshore wind by 70% and offshore wind by 63%.Renewables have now become competitive with fossil fuel power.
Cost of solar in Japan has been reduced by 62% from 2013 to 2020.



Source：IRENA、2024

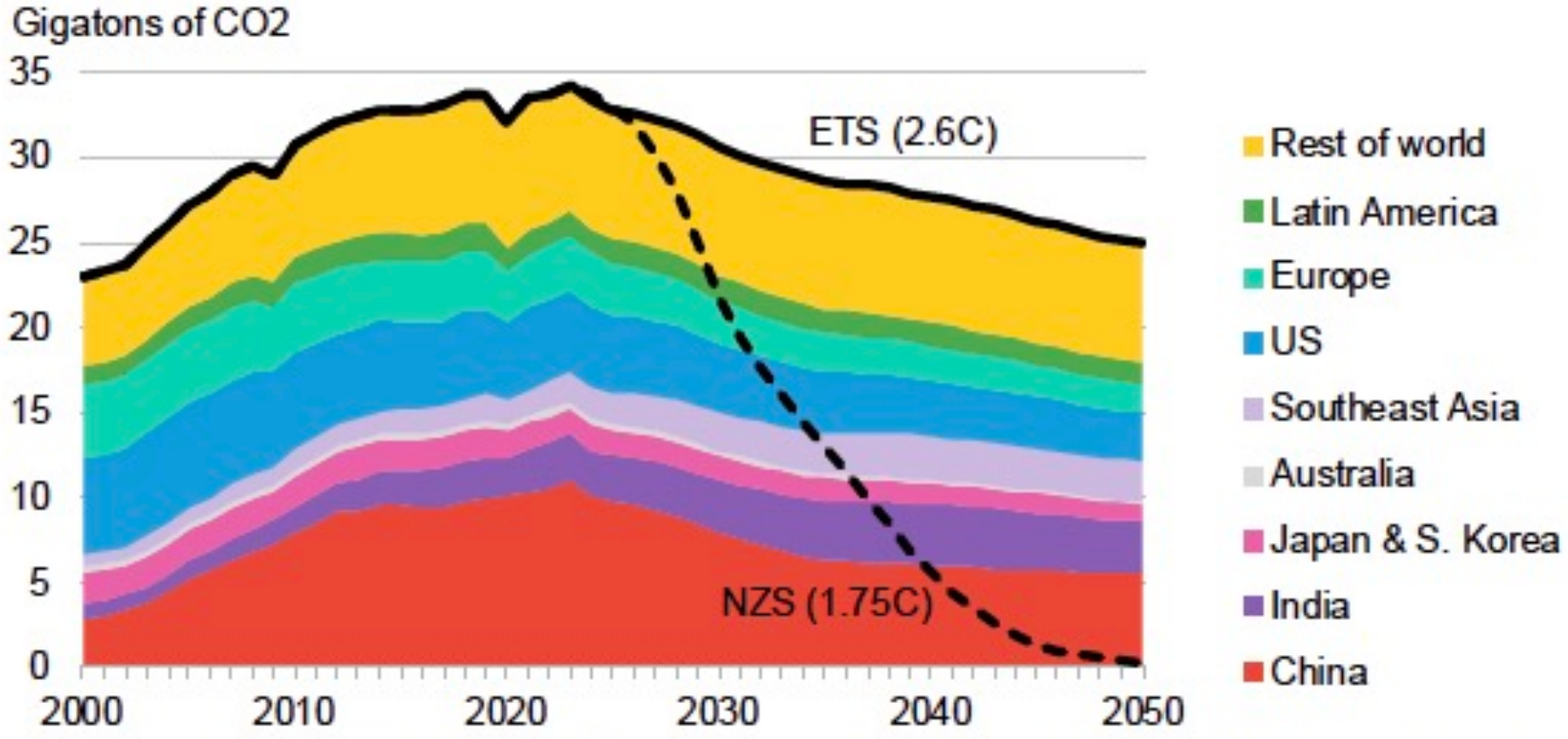
Note: These data are for the year of commissioning. The thick lines are the global weighted average LCOE value derived from the individual plants commissioned in each year. The LCOE is calculated with project-specific installed costs and capacity factors, while the other assumptions, including weighted average cost of capital (WACC), are detailed in Annex I. The grey band represents the fossil fuel-fired power generation cost in 2023, while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

Trends in global electricity mix （Bloomberg NEF, 2024）



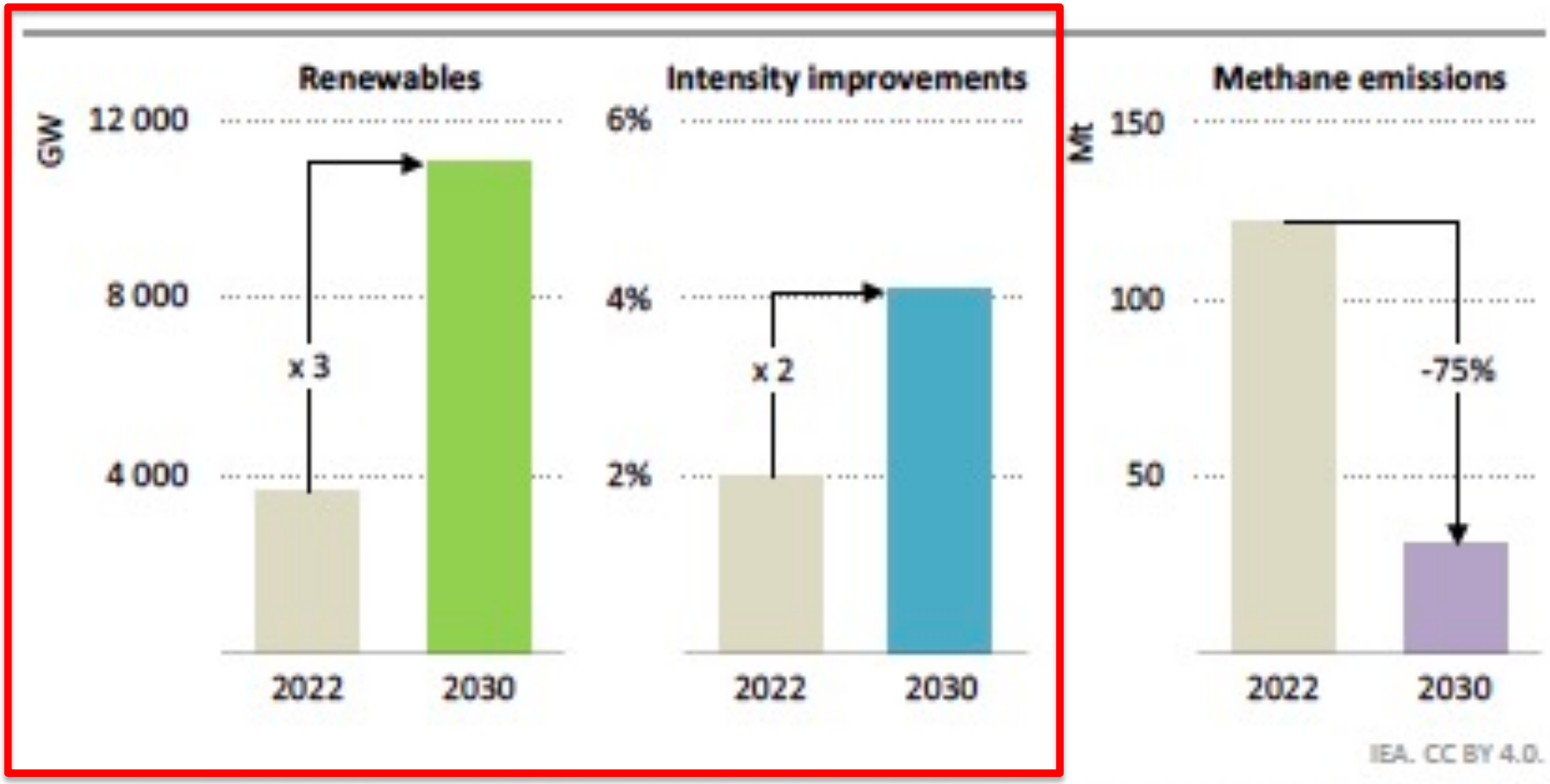
Source: BloombergNEF. Note: Includes electricity generation for hydrogen production under the Net Zero Scenario. 'Other renewables' includes all other non-combustible renewable energy, including hydro, bioenergy, geothermal and solar thermal. CCS is carbon capture and storage.

Global CO2 emissions
（Bloomberg NEF, 2024）



Source: BloombergNEF. Note: ETS is Economic Transition Scenario, NZS is Net Zero Scenario.

Milestone for net zero by 2050



Renewables, energy efficiency and methane emissions reduction options are available today and crucial to reducing near-term emissions

Notes: GW = gigawatts; Mt = million tonnes. For energy intensity improvements, the 2030 value reflects the annual improvement between 2022 and 2030 in the NZE Scenario.

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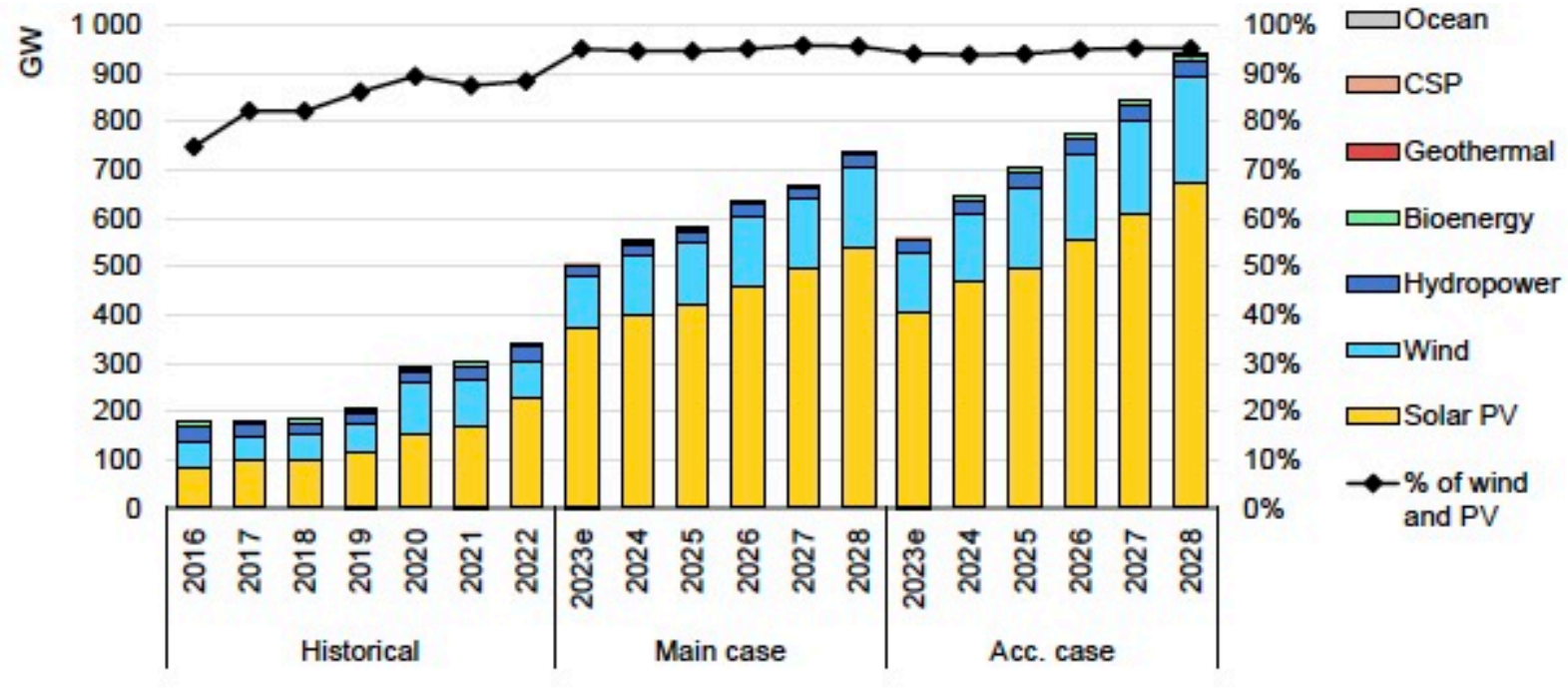
Source: IEA 2023

Annual new renewable capacity additions (global)

In 2023、507GW(estimated) added, increased by 50% from 2022, in more than 130 countries.

In the main case, renewable capacity will reach 2.5 times from now.

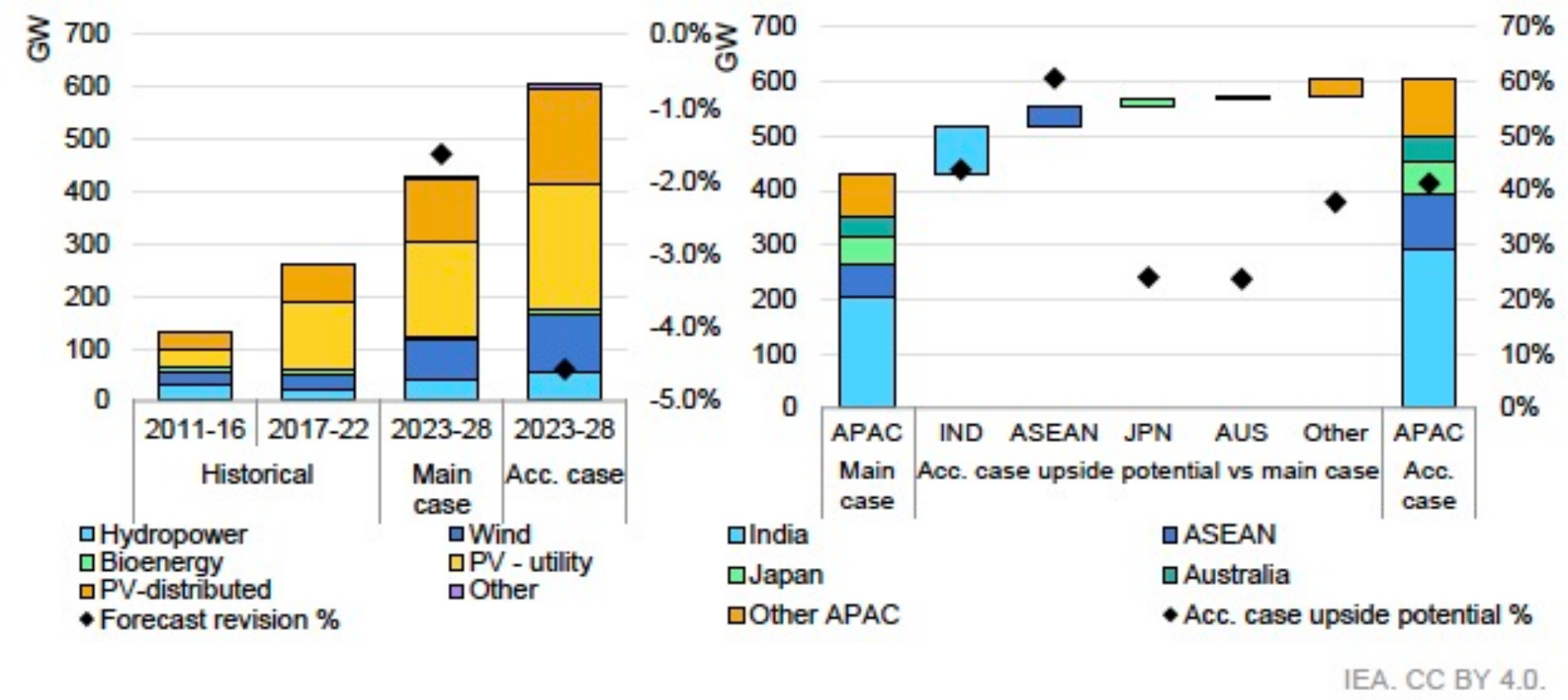


Notes: CSP = concentrated solar power. Capacity additions refer to net additions. Historical and forecast solar PV capacity may differ from previous editions of the renewable energy market report. This year, PV data for all countries have been converted to DC (direct current), increasing capacity for countries reporting in AC (alternating current). Conversions are based on an IEA survey of more than 80 countries and interviews with PV industry associations. Solar PV systems work by capturing sunlight using photovoltaic cells and converting it into DC electricity. The DC electricity is then usually converted using an inverter, as most electrical devices and power systems use AC. Until about 2010, AC and DC capacity in most PV systems were similar, but with developments in PV system sizing, these two values may now differ by up to 40%, especially in utility-scale installations. Solar PV and wind additions include capacity dedicated to hydrogen production.

Source：IEA 2024

New renewable capacity additions （APAC ex-China）

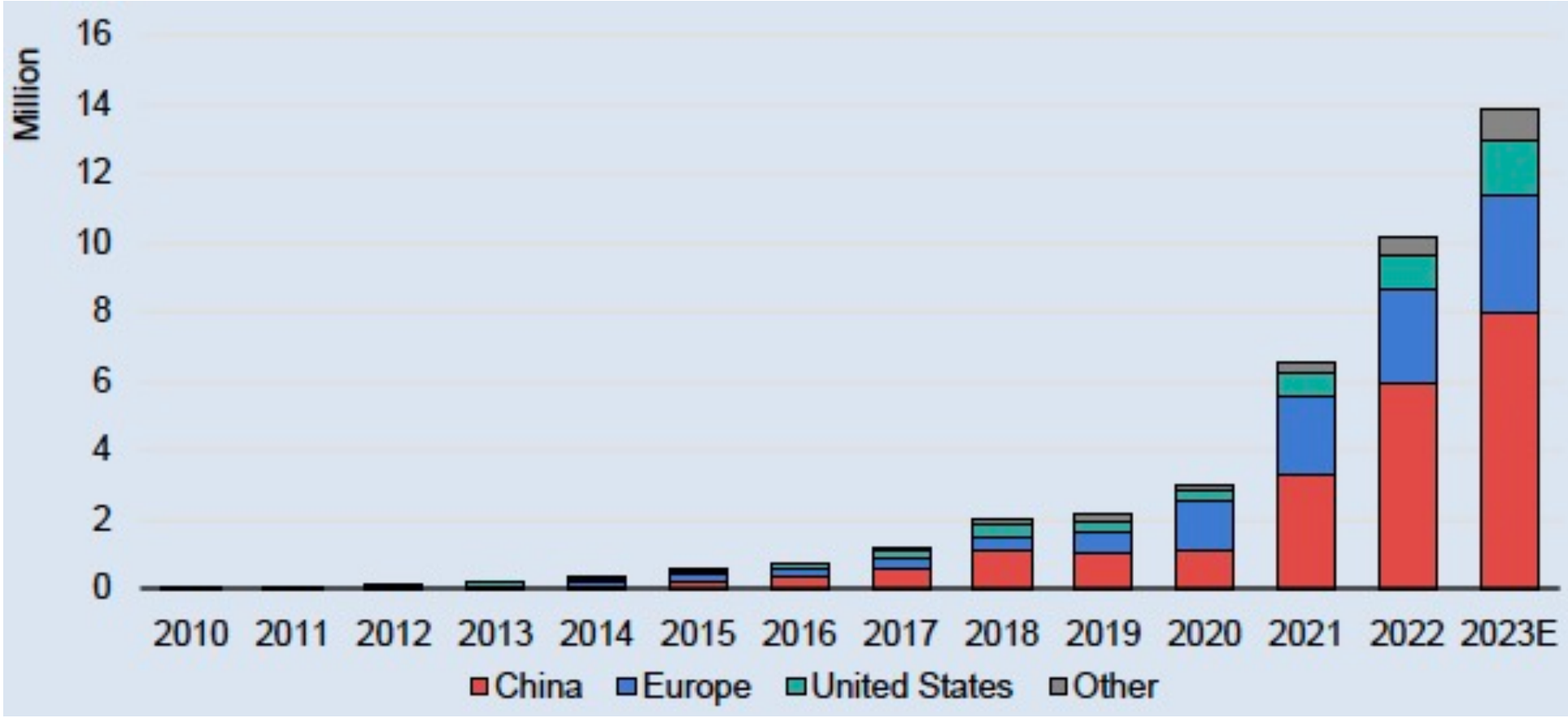
In the main case, renewables are projected to increase by 73% from 2023 to 2028. India accounts for half of the increase, ASEAN 14%, Japan 11%.



Notes: Other includes geothermal and renewable capacity dedicated to hydrogen. APAC = Asia Pacific. IND = India. ASEAN = Association of Southeast Asian Nations. JPN = Japan. AUS = Australia.

Source：IEA 2024

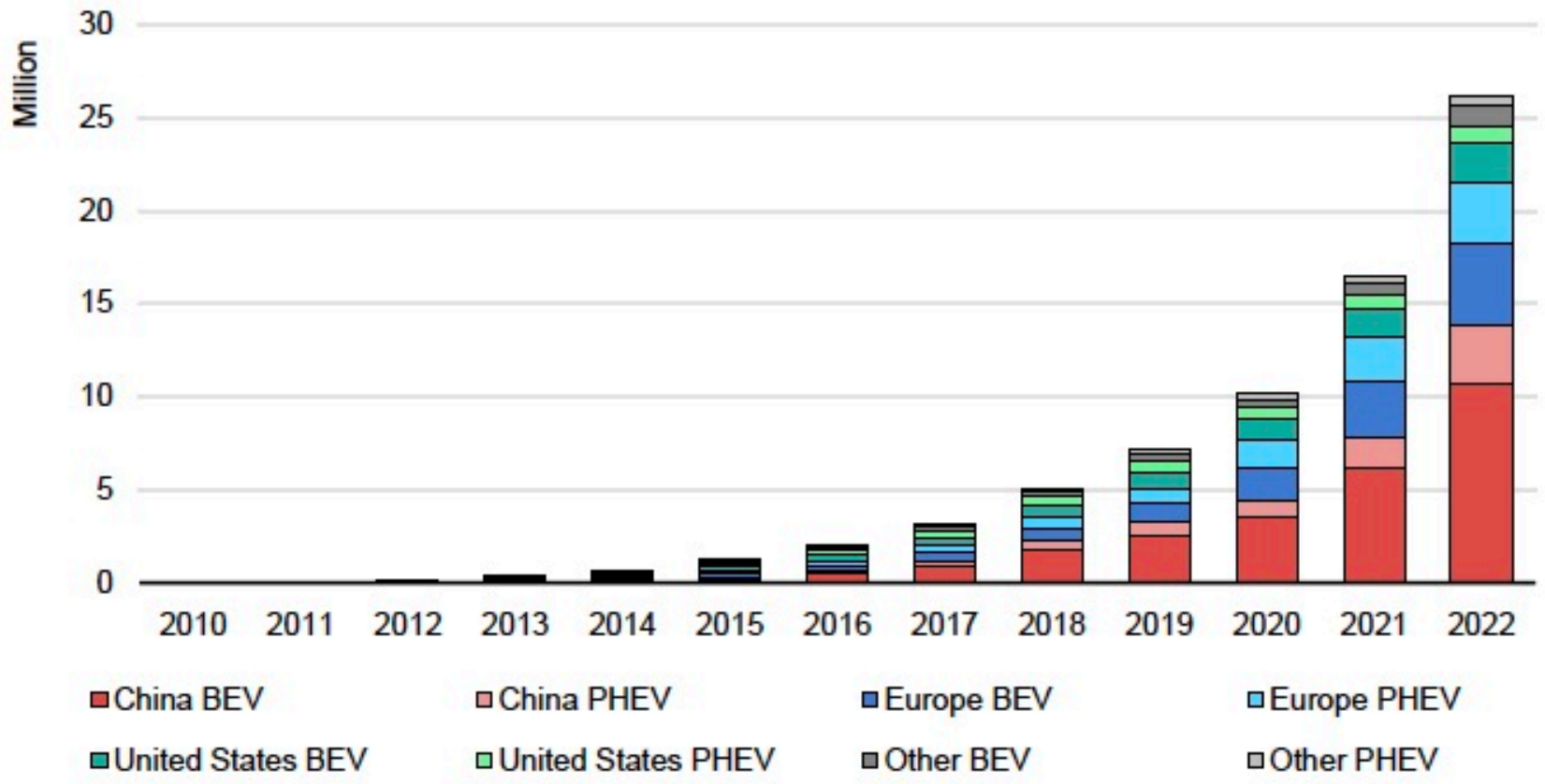
New sales of EVs（2010-2023）



Source: IEA,2023

Stock of EVs（2010-2022）

出典: IEA,2023

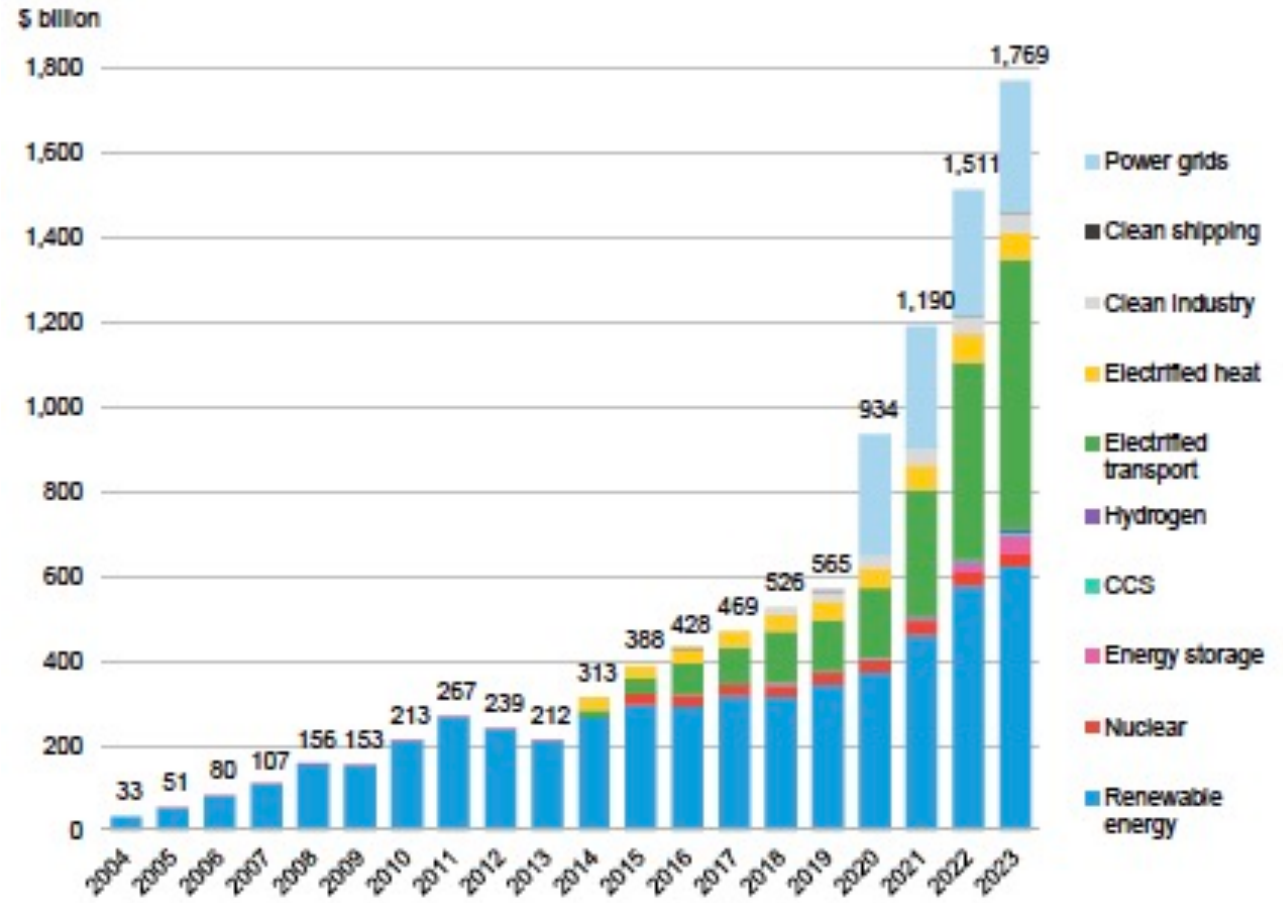


Notes: BEV = battery electric vehicle; PHEV = plug-in hybrid electric vehicle. Electric car stock in this figure refers to passenger light-duty vehicles. In “Europe”, European Union countries, Norway, and the United Kingdom account for over 95% of the EV stock in 2022; the total also includes Iceland, Israel, Switzerland and Türkiye. Main markets in “Other” include Australia, Brazil, Canada, Chile, Mexico, India, Indonesia, Japan, Malaysia, New Zealand, South Africa, Korea and Thailand.

Global investment in energy transition

Energy transition investment surpassed USD 1 trillion in 2022 and achieved USD 1.77 trillion in 2023, increased by 17% from 2022. 4.5 times increase from 2015, 53 times increase from 2004

Investment in renewables record high USD 623.0 billion, increased by 8% from 2022



Source: BloombergNEF. Note: Start years differ by sector but all sectors are present from 2020 onwards; see Methodology for more detail. Most notably, nuclear figures start in 2015 and power grids in 2020. CCS refers to carbon capture and storage.

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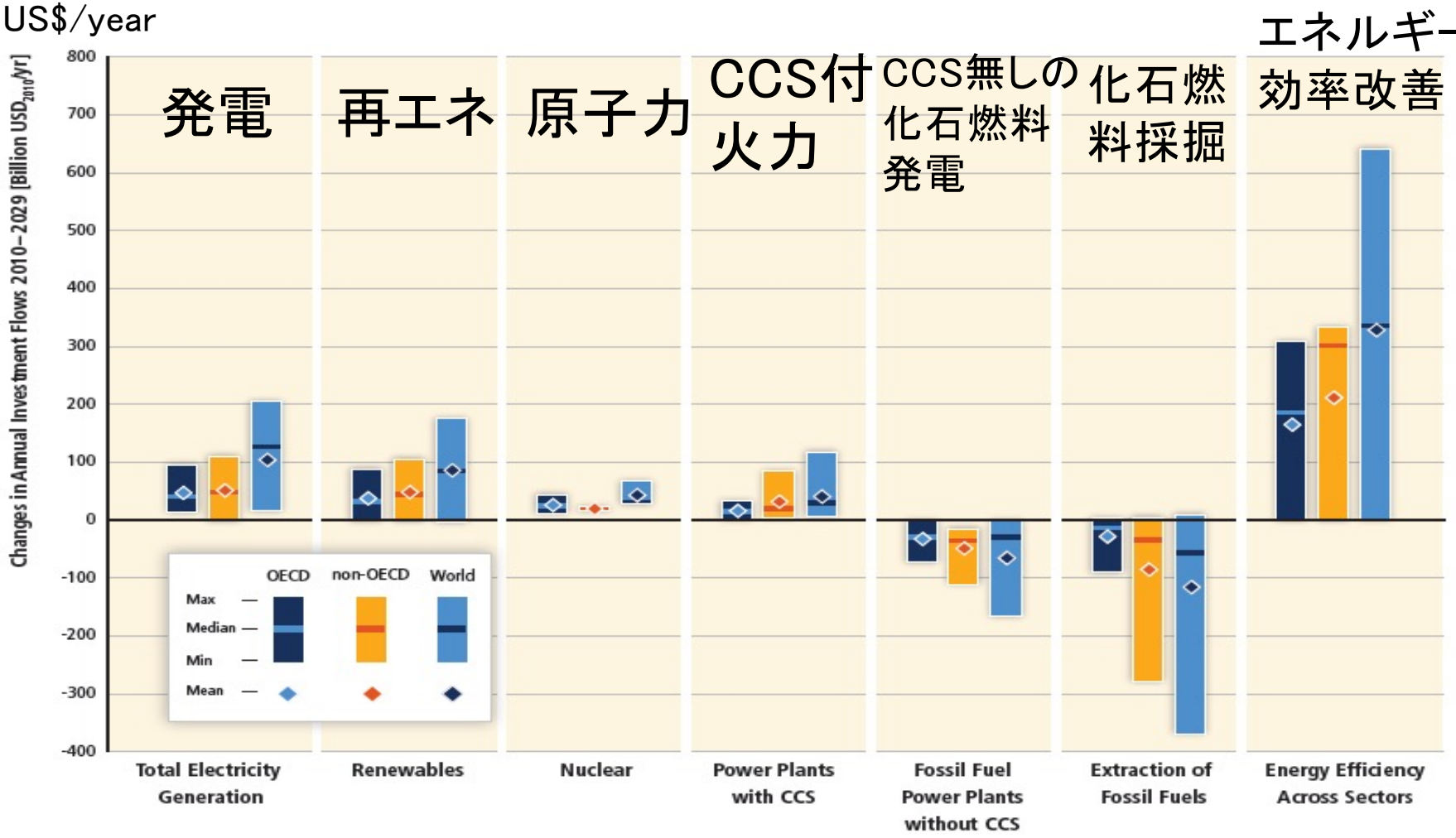
Source: BloombergNEF, 2024

2°C goal and change in annual investment flow from average baseline（2010-2029）

Substantial reductions in emissions would require large changes in investment patterns

Annual investment in low-carbon electricity supply and in energy efficiency should rise.

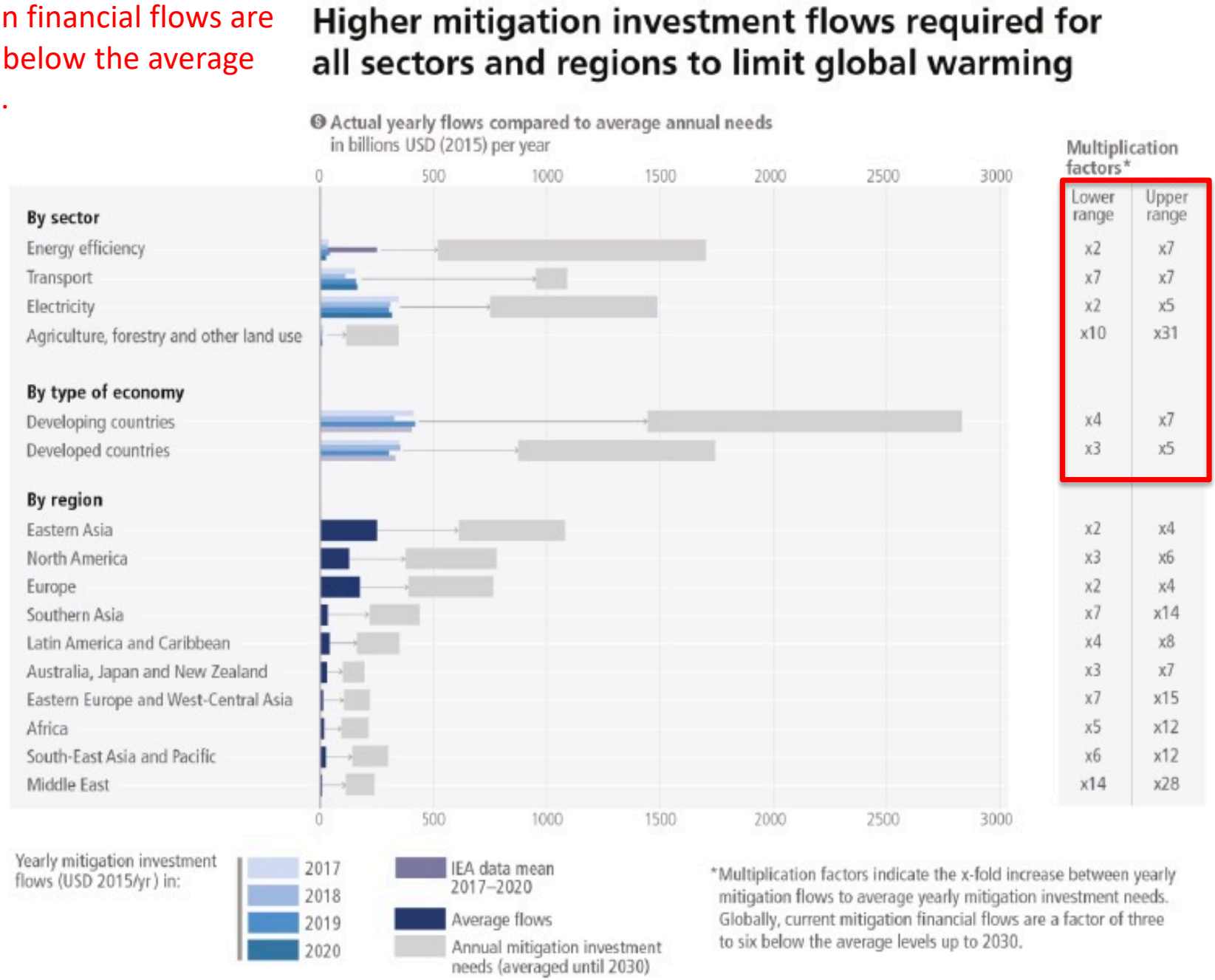
Billion US$/year



Source：IPCC, 2014

Source：IPCC AR6 Synthesis Report, 2023

Current mitigation financial flows are a factor of 3 to 6 below the average levels up to 2030.

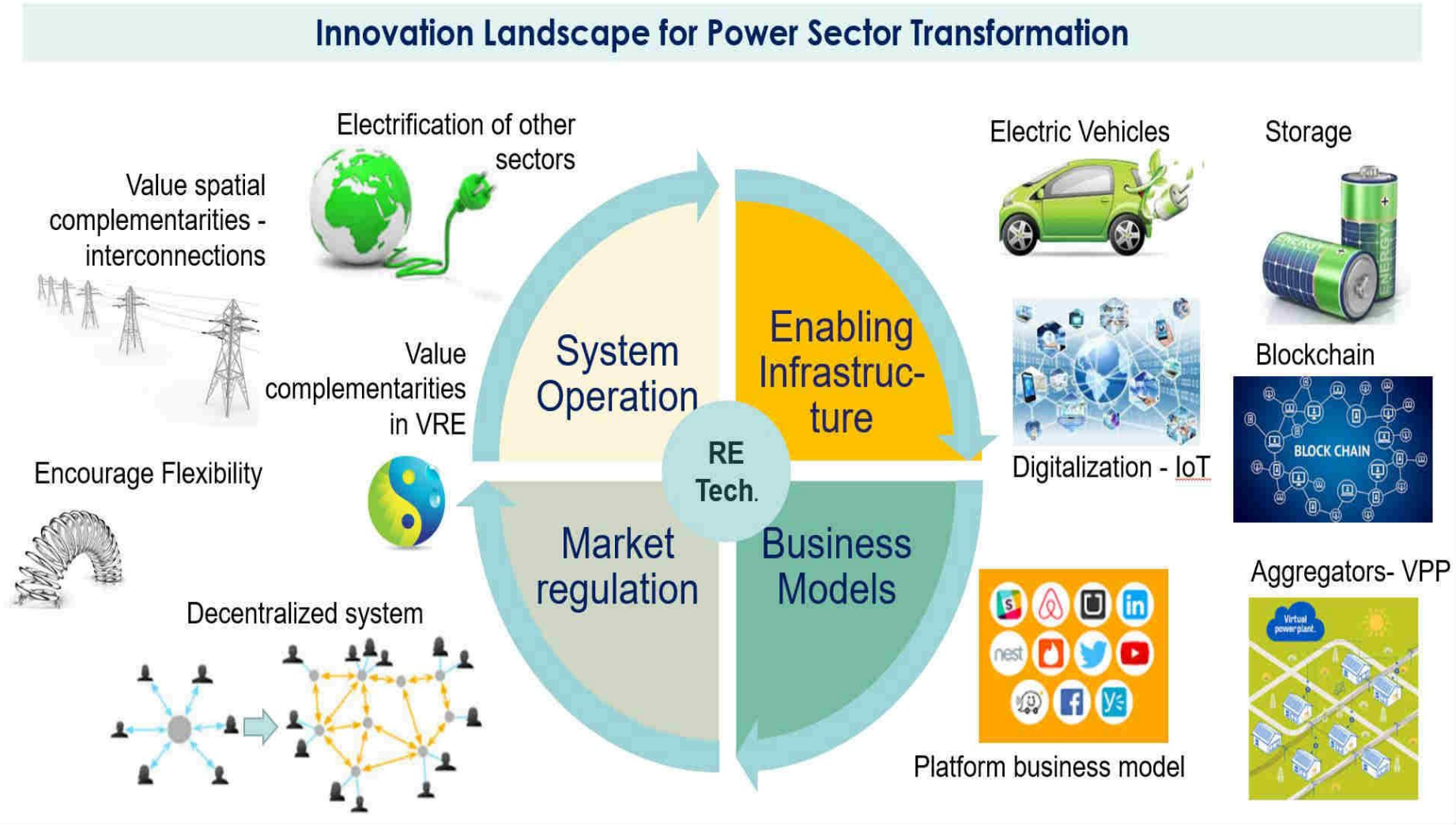


3D : Decarbonization, Decentralization and Digitalization

Innovation progresses across the sectors (through sector coupling)

"Grid integrated efficient buildings" "Grid interactive efficient buildings"

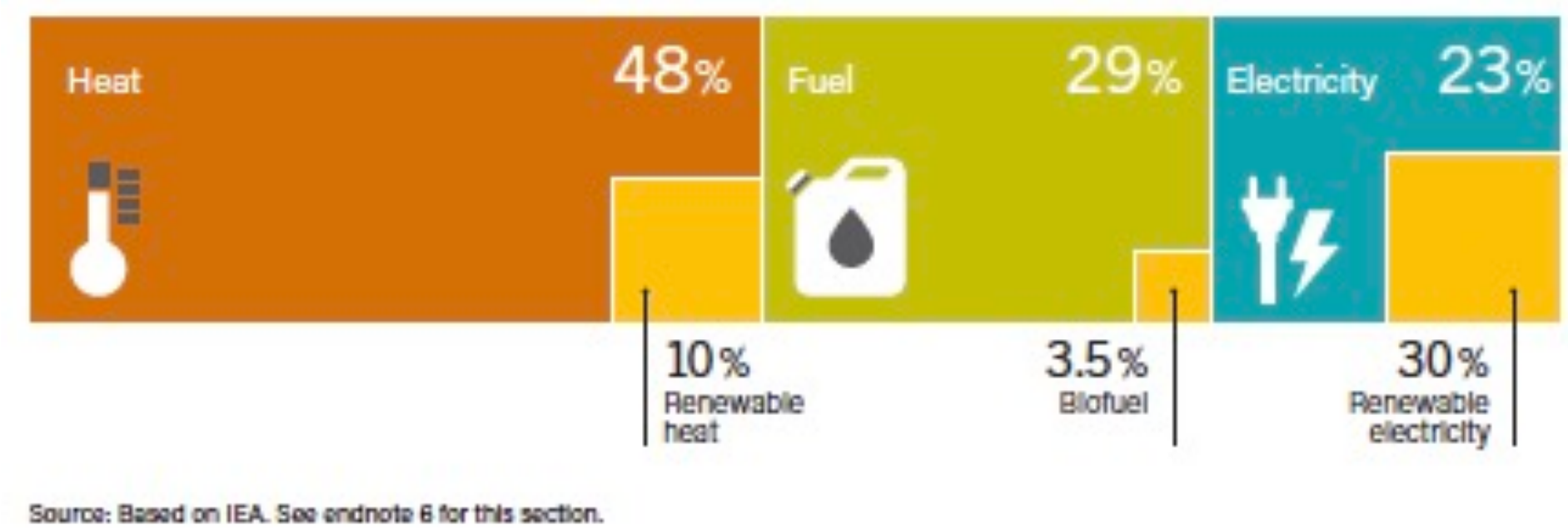
Complementarity of technologies 技術の補完性



Source: IRENA, 2017

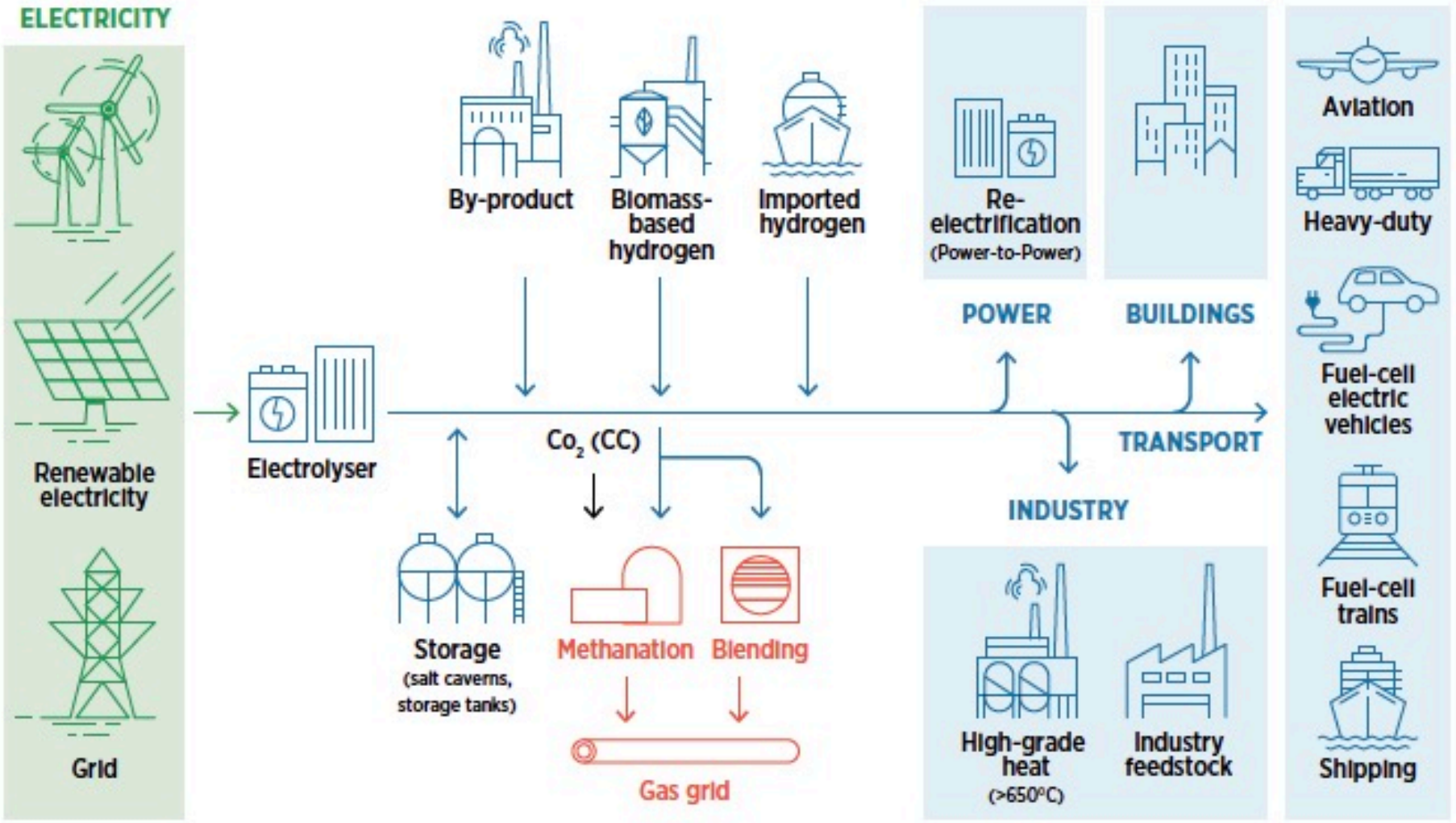
最終エネルギー消費に占める再生可能エネルギー（2021）
Renewable Energy in TFEC by Sector

Electricity accounts for about one fourth of final energy consumption.
More difficult challenges are heating and cooling, and transport.



Source：REN21, 2024

Sector Coupling
Power to X
Energy System Integration



Source: IRENA, 2018

Impacts of Paris long-term goal

- Regulation of CO2 emission from international aviation by International Civil Aviation Organization（ICAO）
  - Global market-based mechanism (Carbon offsetting and Reduction Scheme for International Aviation (CORSIA))
  - Net zero emission by 2050 (Oct. 2022)

- Long-term goal for GHG emission reduction from International maritime transport by International Maritime Organization (IMO) (July 2023)
  - "to peak GHG emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, i.e. close to, 2050, taking into account different national circumstances, whilst pursuing efforts towards phasing them out as called for in the Vision consistent with the long-term temperature goal set out in Article 2 of the Paris Agreement. Reducing GHG emission" (2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS adopted by MEPC on 7 July 2023)

- 15 October 2016：Amendment of the Montreal Protocol to phases down HFCs (Kigali Amendment)

HFCs phase down under the Montreal Protocol

- 15 October 2016 : Amendment of the Montreal Protocol to phases down HFCs (Kigali Amendment)
- Entry into force from 1 January 2019.

	A5 parties (developing countries) - *Group 1*	A5 parties (developing countries) - *Group 2*	Non-A5 parties (developed countries)
Baseline formula	Average HFC consumption for 2020-2022 + 65% of hydrochlorofluorocarbon (HCFC) baseline	Average HFC consumption for 2024-2026 + 65% of HCFC baseline	Average HFC consumption for 2011-2013 + 15% of HCFC baseline*
Freeze	2024	2028	-
1st step	2029 – 10%	2032 – 10%	2019 – 10%
2nd step	2035 – 30%	2037 – 20%	2024 – 40%
3rd step	2040 – 50%	2042 – 30%	2029 – 70%
4th step	-	-	2034 – 80%
Plateau	2045 – 80%	2047 – 85%	2036 – 85%

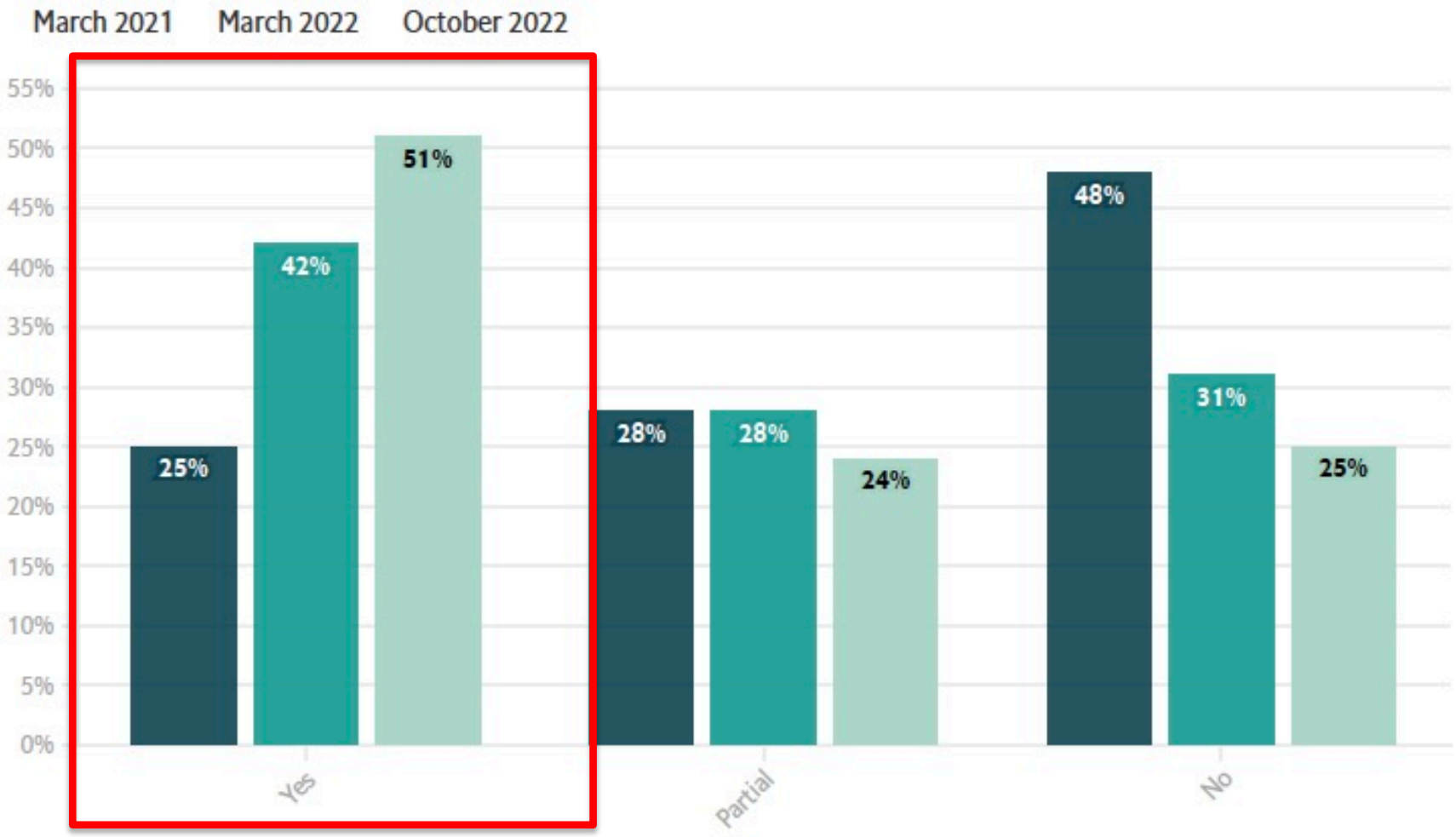
* For Belarus, Russian Federation, Kazakhstan, Tajikistan, Uzbekistan, 25% HCFC component of baseline and different initial two steps (1) 5% reduction in 2020 and (2) 35% reduction in 2025

"New normal" towards net zero

- "New normal": Dynamic and drastic changes in businesses towards green economy, especially "net zero by 2050"
  - Most of large companies and of listed companies commit themselves to "net zero by 2050" at the latest, decarbonzation goal.
  - Companies, including banks and financial institutions, do also commit themselves to reduceing scope 3 emissions (emissions from their supply chain and value chain), which means that companies request/encourage its suppliers to reduce their emissions.
    - Ex: Microsoft: (Potential) suppliers are requested to submit its scope 1 and 2 emissions plus scope 3 emissions for being selected as its supplier
    - Ex: Apple: requests its suppliers to produce Apple product by renewables by 2030
    - Ex: Hitachi: its carbon neutrality by 2030 and 100% reduction of its scope 3 emission by 2050
    - Ex: Banking corporations: net zero by 2050 of its portfolio of investment and loan with interim target of 2030 (around 50%)
- How companies manage climate issue is considered as business risks and opportunities, which impacts corporate value and competitiveness.

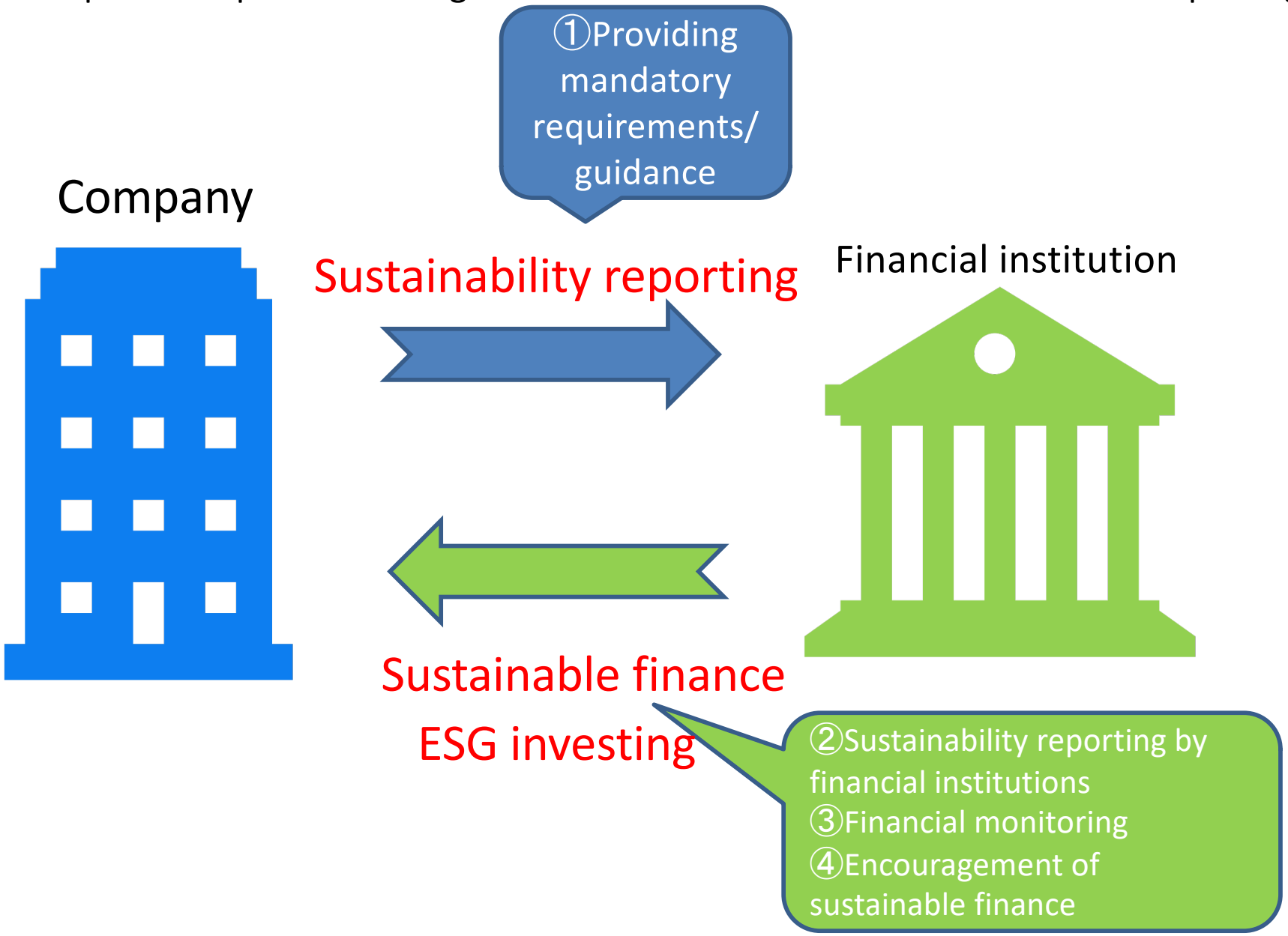
Corporate net-zero commitments are rising

% of focus companies with a net zero greenhouse-gas (GHG) emissions by 2050—or sooner—ambition

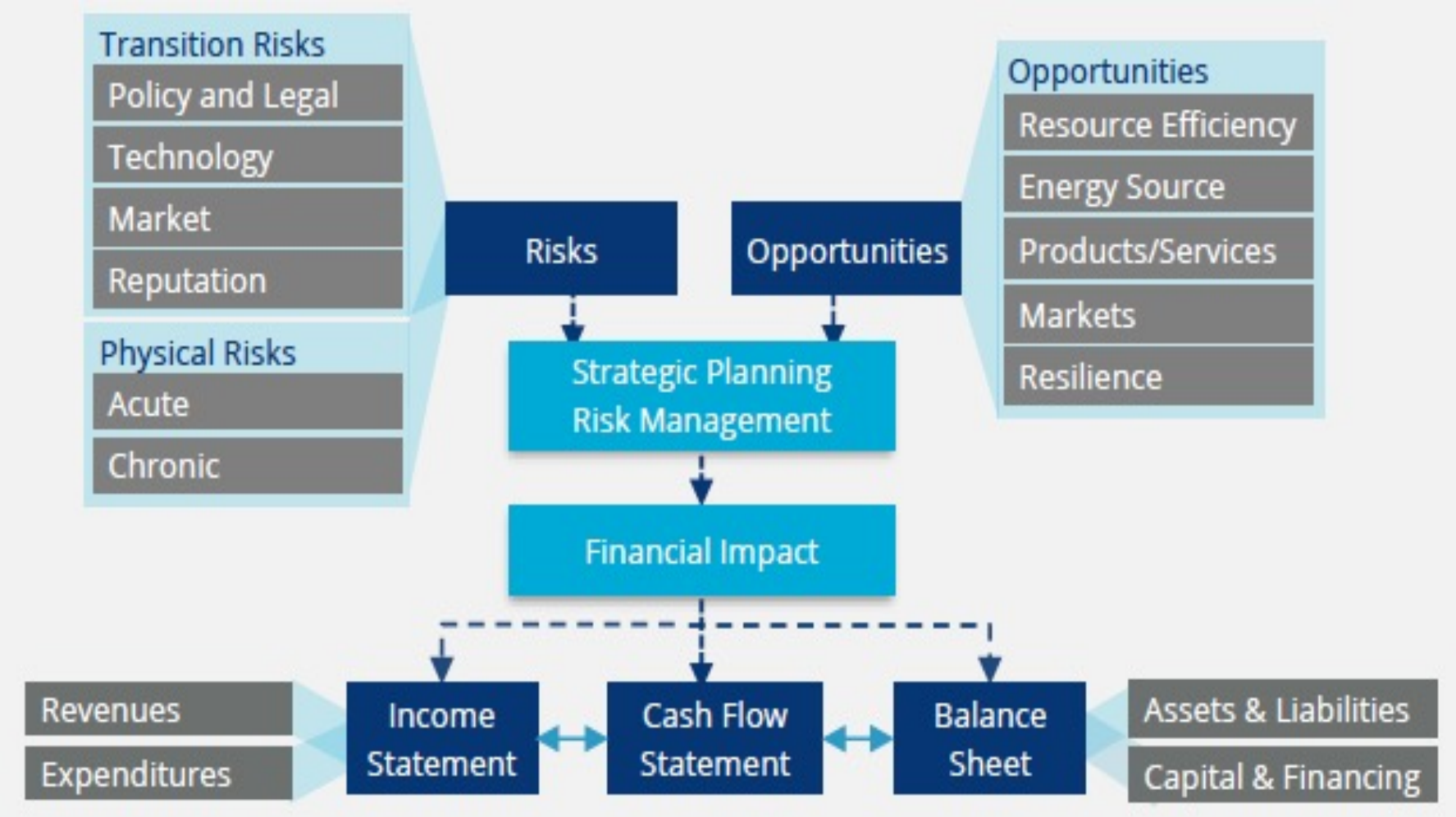


Source: Climate Action 100+ Net Zero Company Benchmark Interim assessments, 2022 • Note: Considers Climate Action 100+ focus companies only. 159 of 166 focus companies were assessed. Three-quarters (75%) of the world's largest corporate GHG emitters have set a net-zero by 2050 (or sooner) ambition that covers, at least, their Scope 1 and 2 GHG emissions. This is up from 69% in March 2022.

Financial institutions request companies to undertake disclosure of climate related risk, covering the whole supply chain, through “Engagement, Voting and Divestment” as well as proposals put forward by shareholders, including institutional investors
Governments push companies to integrate climate risks into their business and do reporting.



TCFD: Financial impact of climate related risks and opportunities



Sustainability Reporting Standards

	International	Japan domestic
June 2021	・Launch of Task Force on Nature Related Financial Disclosure (TNFD)	・Amendment of Corporate Governance Code, requiring companies to undertake climate related financial disclosure in line with TCFD recommendations
November 2021	・IFRS（International Financial Reporting Standards）Foundation establishes International Sustainability Standards Board（ISSB）	
March 2022	・US Secruty Excanges Committee（SEC） issues draft of climate related disclosure regulation	
June 2022		・Financial Council recommend to include sustainability reporting in companies' financial statement
July 2022		・Financial Accounting Standards Foundation（FASF） establishs Sustainability Standards Board of Japan (SSBJ)
2023	・EU CSRD entered into effect (January 2023) ・Release of sustainability reporting requirements and climate disclosure requirements by ISSB (June 2023) ・Release of TNFD recommendations (September 2023)	・Amend regulations to oblige companies to sustainability reporting in their financial statement (January 2023).
2024	・Commission delegated regulation (EU) on sustainability reporting standards (ESRS) entered into force (January. 2024)	・Draft of Japanese standards will be published (March 2024) to be finalized in March 2025 at the latest

International Sustainability Standards Board（ISSB）

- Established in November 2021
- 2 sets of standards published in June 2023
  - IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information
  - IFRS S2 Climate-related Disclosures

- Considering workplan for 2024-2025
  - Focus on biodiversity, ecosystem, ecosystem services (BEES) and human capital.

Financial institutions and investors move toward net zero of investment portfolio

Net-Zero Asset Owner Alliance（launched in Sep. 2019）

- initiative of institutional investors (pension funds and insurance companies) committed to transitioning their investment portfolios to net-zero GHG emissions by 2050 – consistent with a maximum temperature rise of 1.5℃.
- set intermediate targets, which include CO2 reduction ranges for 2025 (22 – 32%) and for 2030 (40% – 60%).
- 88 asset owners with USS 9.5trillion in assets under management (AUM)

Net Zero Asset Managers Initiative（launched in Dec. 2020）

- international group of asset managers committed to supporting the goal of net zero GHG emissions by 2050 or sooner, in line with global efforts to limit warming to 1.5 degrees Celsius; and to supporting investing aligned with net zero emissions by 2050 or sooner.
- 325 signatories with USD 57.5 trillion in AUM

Net-Zero Banking Alliance（launched in Apr. 2021）

- global group of banks, currently representing over 40% of global banking assets, which are committed to aligning their lending and investment portfolios with net-zero emissions by 2050.
- 145 Banks of 44 countries with total assests of USD 74trn

Trends in Sustainable Investing (EU, US, Canada, Australia and NZ and Japan)

Growth of sustainable investing assets by region in local currency, 2014 – 2022

						GROWTH PER PERIOD				COMPOUND ANNUAL GROWTH RATE (CAGR) 2014-2020
	2014	2016	2018	2020	2022	2014-2016	2016-2018	2018-2020	2020-2022	
Europe (EUR)	€9,885	€11,045	€12,306	€10,730	€12,401	12%	11%	-13%	31%	4%
United States (USD)	$6,572	$8,723	$11,995	$17,081	$8,400	33%	38%	42%	-51%	3%
Canada (CAD)	$1,011	$1,505	$2,132	$3,166	$3,014	49%	42%	48%	-5%	15%
Australia & New Zealand (AUS)	$203	$707	$1,033	$1,295	$1,680	248%	46%	25%	30%	30%
Japan (JPY)	¥840	¥57,056	¥231,952	¥310,039	¥493,598	6692%	307%	34%	59%	122%

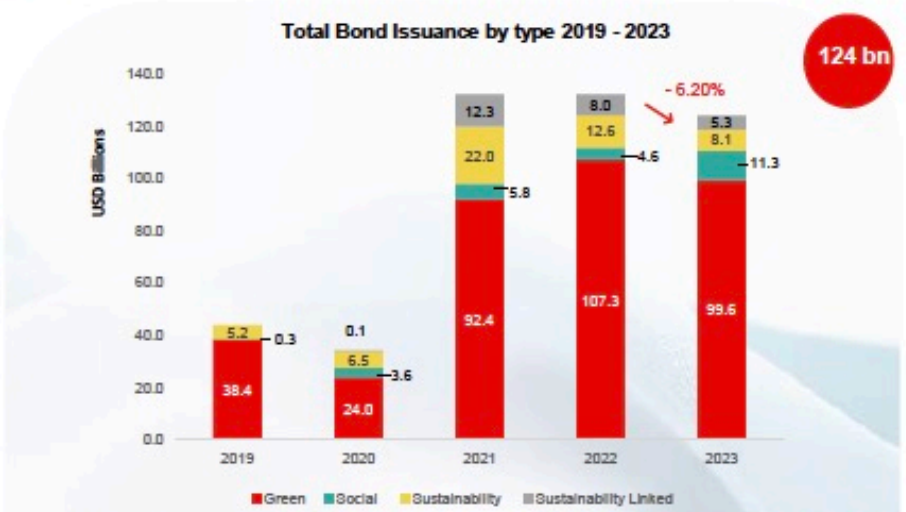
NOTE: Asset values are expressed in billions. All figures are in regional currencies. New Zealand assets were converted to Australian dollars.

※Significant changes in definitions of sustainable investment in Europe and Australia and New Zealand, as observed in the 2020 report, followed by revision of definition for US and Canada.

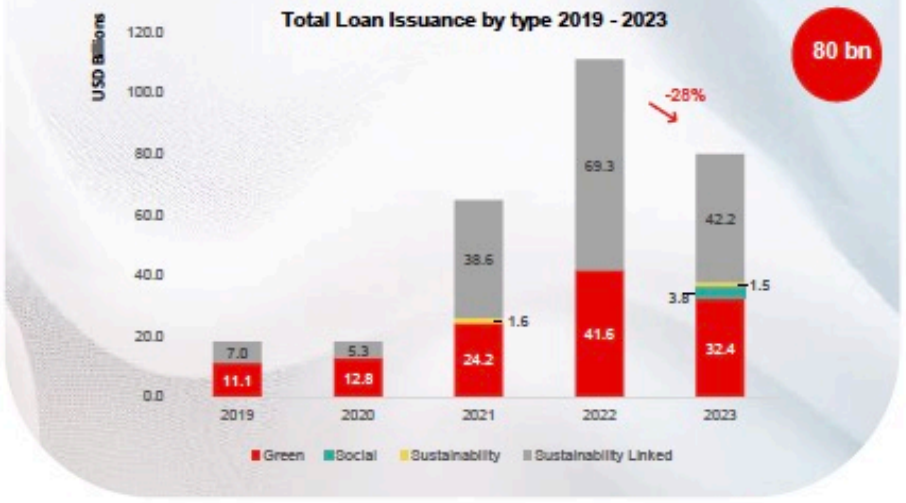
Source: Global Sustainable Investment Alliance, 2023

APAC (ex-Japan) ESG Bond and Loan

Despite interest rate fluctuations and an interim slowdown globally, sustainable financing in APAC (ex-Japan) remained active



2.8x
Growth over the past 5 years



4.4x
Growth over the past 5 years

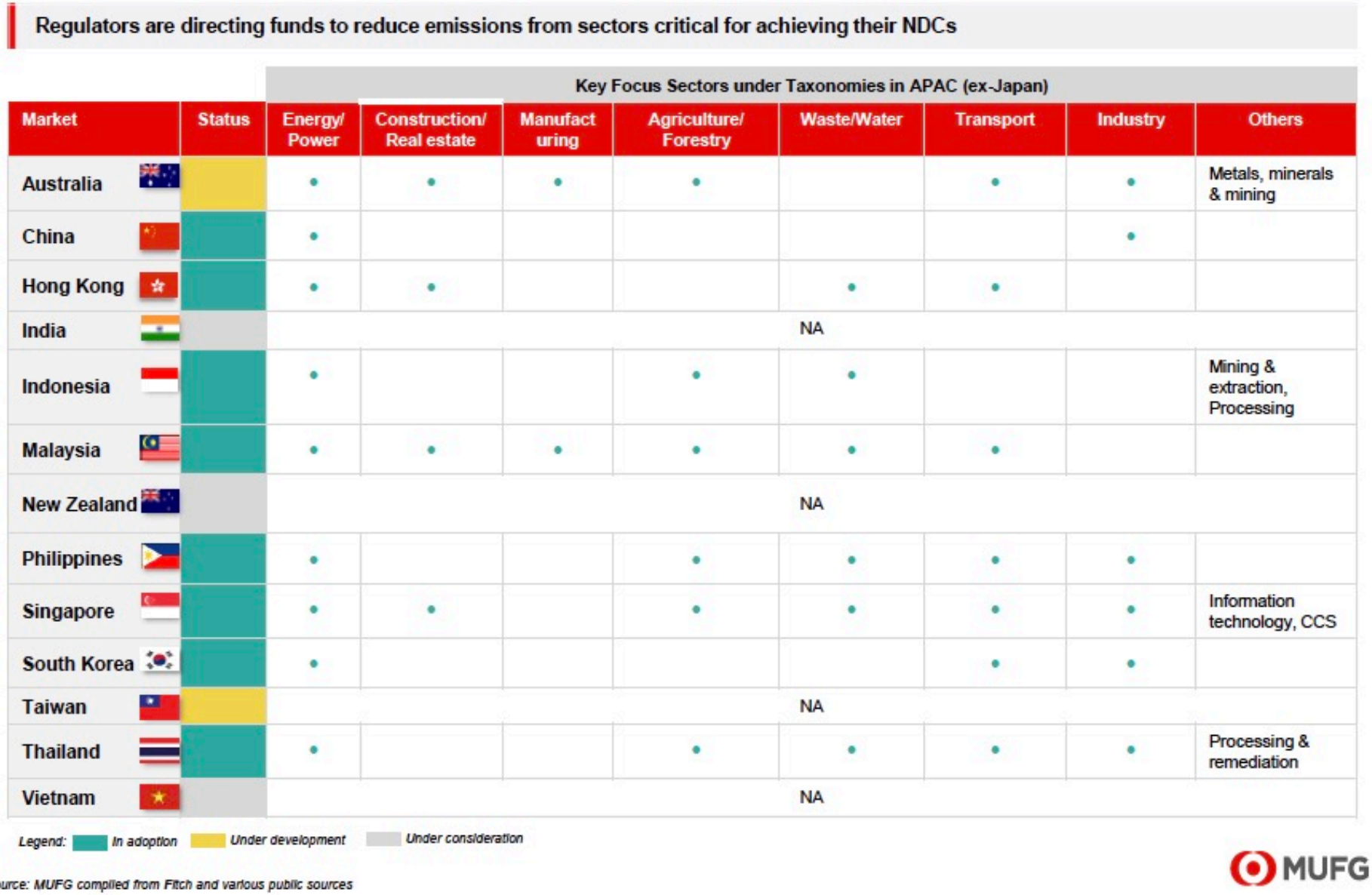
- APAC's Sustainable Debt Market remained strong with continued expansion in decarbonisation activities such as renewable energy, green buildings, clean transportation & energy storage facilities
- Social loans emerge again in 2023 with financial institutions in India & South Korea being the top issuers
- Sustainability-linked loans (SLLs) remained popular, targeting a wider range of borrowers with both environmental & social KPIs to tackle ESG issues more broadly

Source: Loanradar, Refinitiv, Dealogic, Bloomberg, Sustainable Fitch, Robecco Note - Deal volumes have been rounded off to the nearest decimals.

MUFG

Source: MUFG, 2024

Sustainable Finance Taxonomies(APAC)



Regulators are directing funds to reduce emissions from sectors critical for achieving their NDCs

		Key Focus Sectors under Taxonomies in APAC (ex-Japan)							
Market	**Status**	**Energy/ Power**	**Construction/ Real estate**	**Manufacturing**	**Agriculture/ Forestry**	**Waste/Water**	**Transport**	**Industry**	**Others**
Australia		•	•	•	•		•	•	Metals, minerals & mining
China		•						•	
Hong Kong		•	•			•	•		
India						NA			
Indonesia		•			•	•			Mining & extraction, Processing
Malaysia		•	•	•	•	•	•		
New Zealand						NA			
Philippines		•			•	•	•	•	
Singapore		•	•		•	•	•	•	Information technology, CCS
South Korea		•					•	•	
Taiwan						NA			
Thailand		•			•	•	•	•	Processing & remediation
Vietnam						NA			

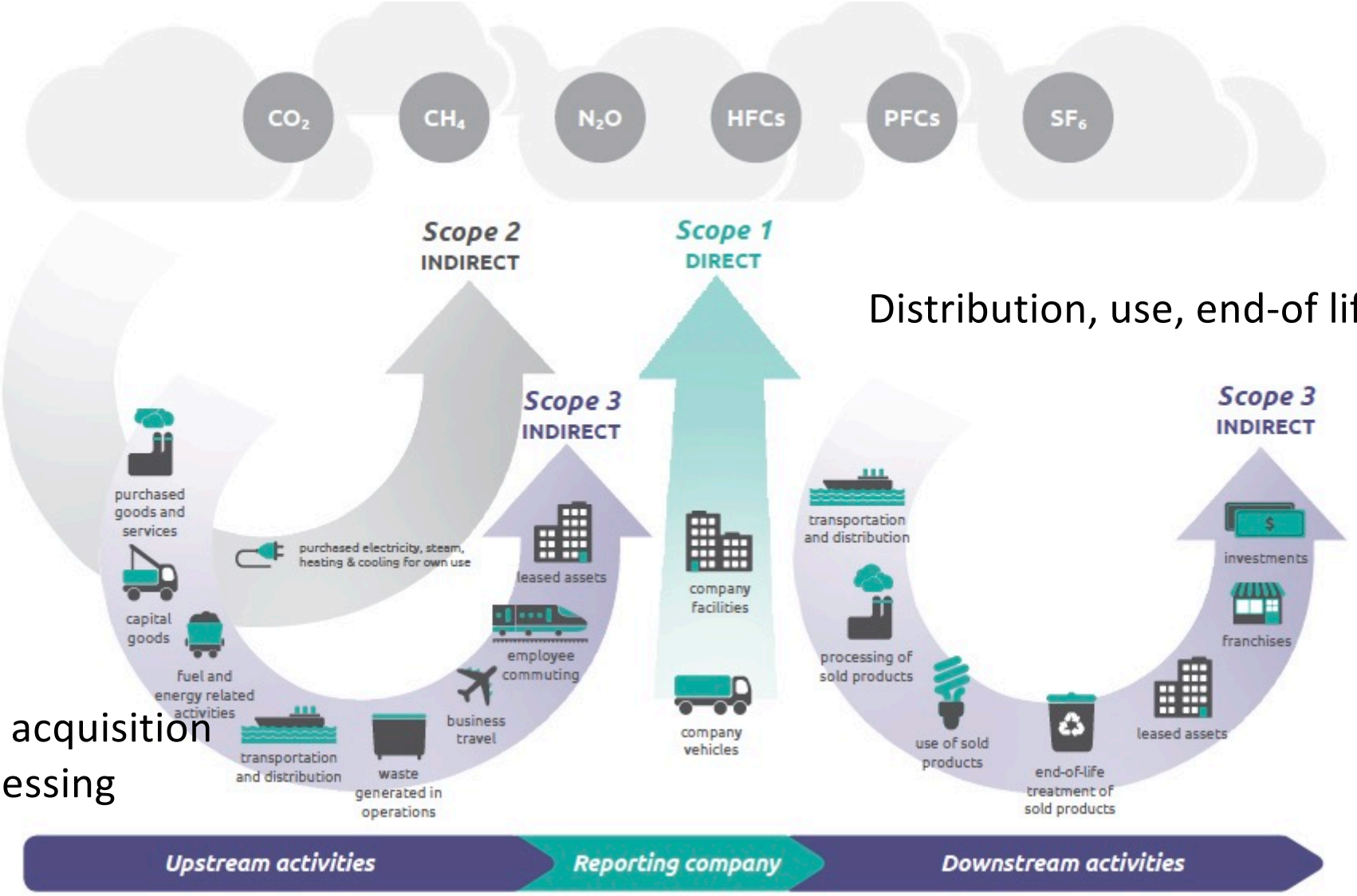
Legend: *In adoption* *Under development* *Under consideration*

Source: MUFG compiled from Fitch and various public sources

Source: MUFG, 2024

Scope 3 emissions

Value chain emissions



Distribution, use, end-of life

Material acquisition
Pre-processing

Source : WRI/WBCSD Corporate Value Chain (Scope 3) Accounting and Reporting Standard, 2011

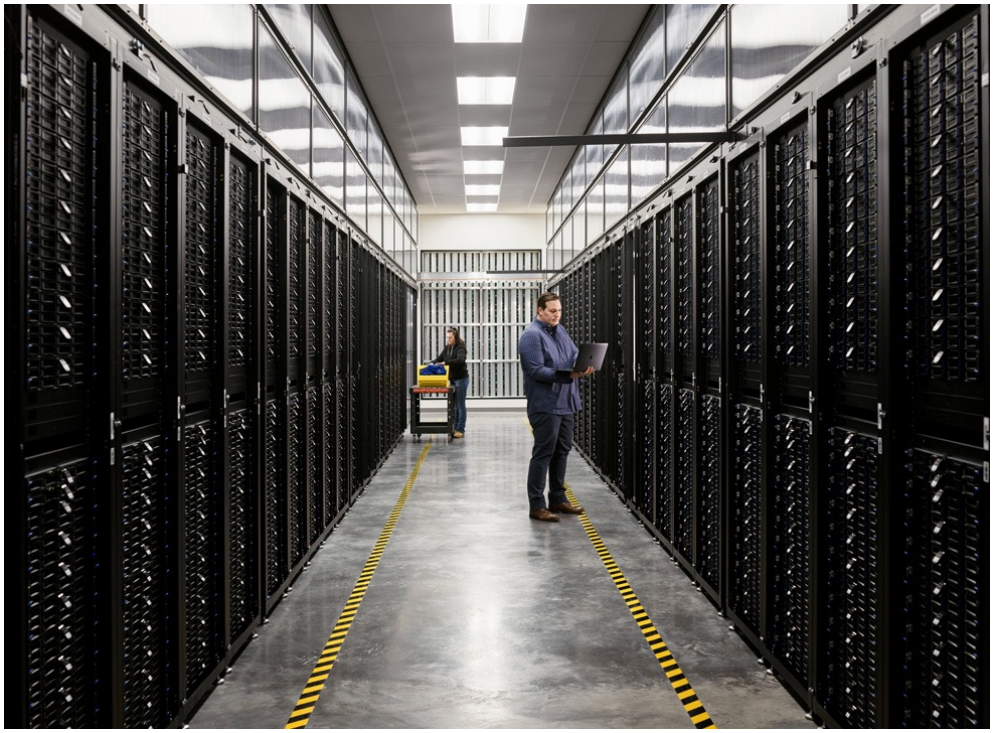
Microsoft: “Climate Moonshot”（16 January 2020）

- Carbon negative by 2030
- Remove our historical carbon emission by 2050
- $1 billion climate innovation fund
- Scope 1 and 2 emissions to near zero by the middle of this decade
  - By 2025, shift to 100 percent supply of renewable energy.
- Reduce scope 3 emissions by more than half by 2030 through new steps
  - Since 2021, MS begins to implement new procurement processes and tools to enable and incentivize our suppliers to reduce their scope 1, 2, and 3 emissions.

https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/

Apple: carbon neutral 2030 （16 July 2020）

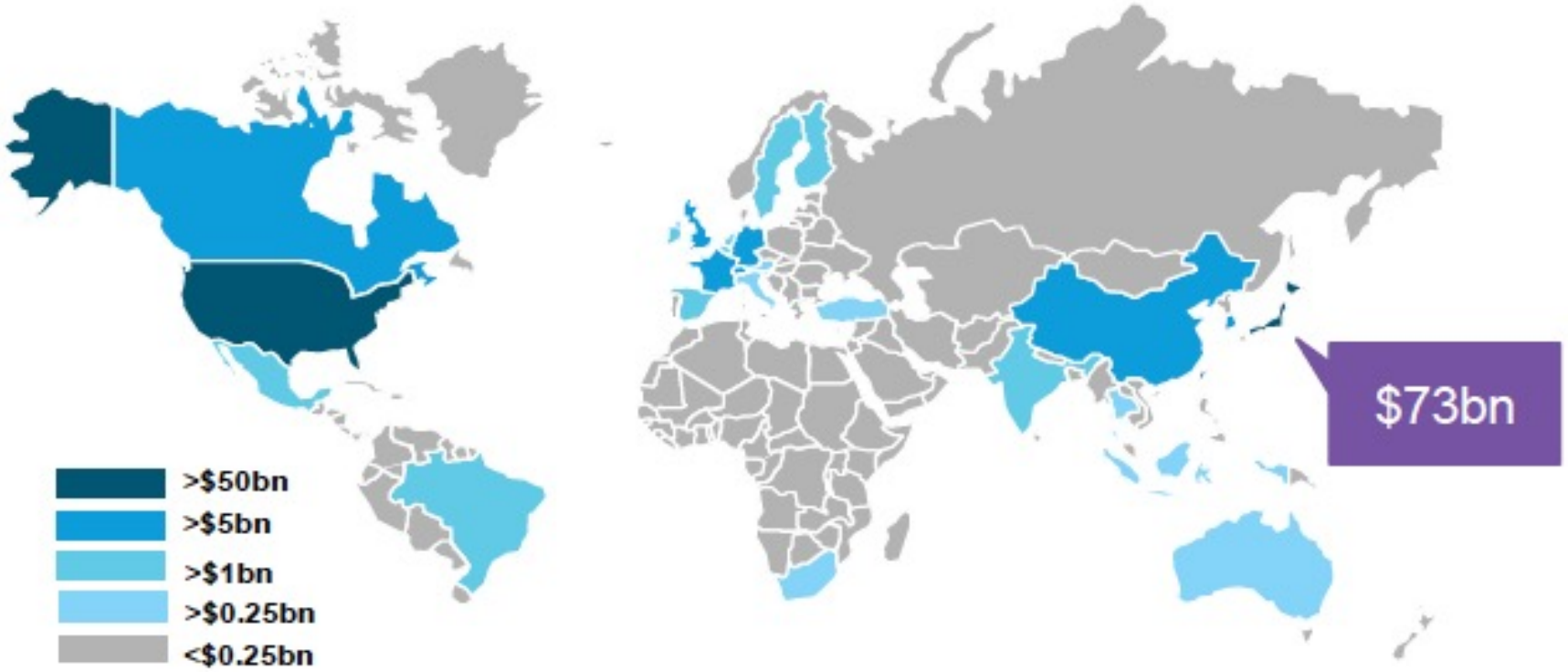
- Apple commits to be 100% carbon neutral for its supply chain and products
  - Low carbon product design
  - Energy efficiency
  - Renewable energy
  - Process and material innovations
  - Carbon removal
- Already 100% renewable energy for its operations
- Focusing on creating new projects and moving its entire supply chain to clean power.
- More than 200 manufacturing partners including 35 Japanese companies have committed to 100 percent renewable energy for Apple production by 2030



https://www.apple.com/newsroom/2020/07/apple-commits-to-be-100-percent-carbon-neutral-for-its-supply-chain-and-products-by-2030/

Business risk due to difficulty in procuring renewable energy

Japanese companies have faced business risk leading to 73 billion dollars.

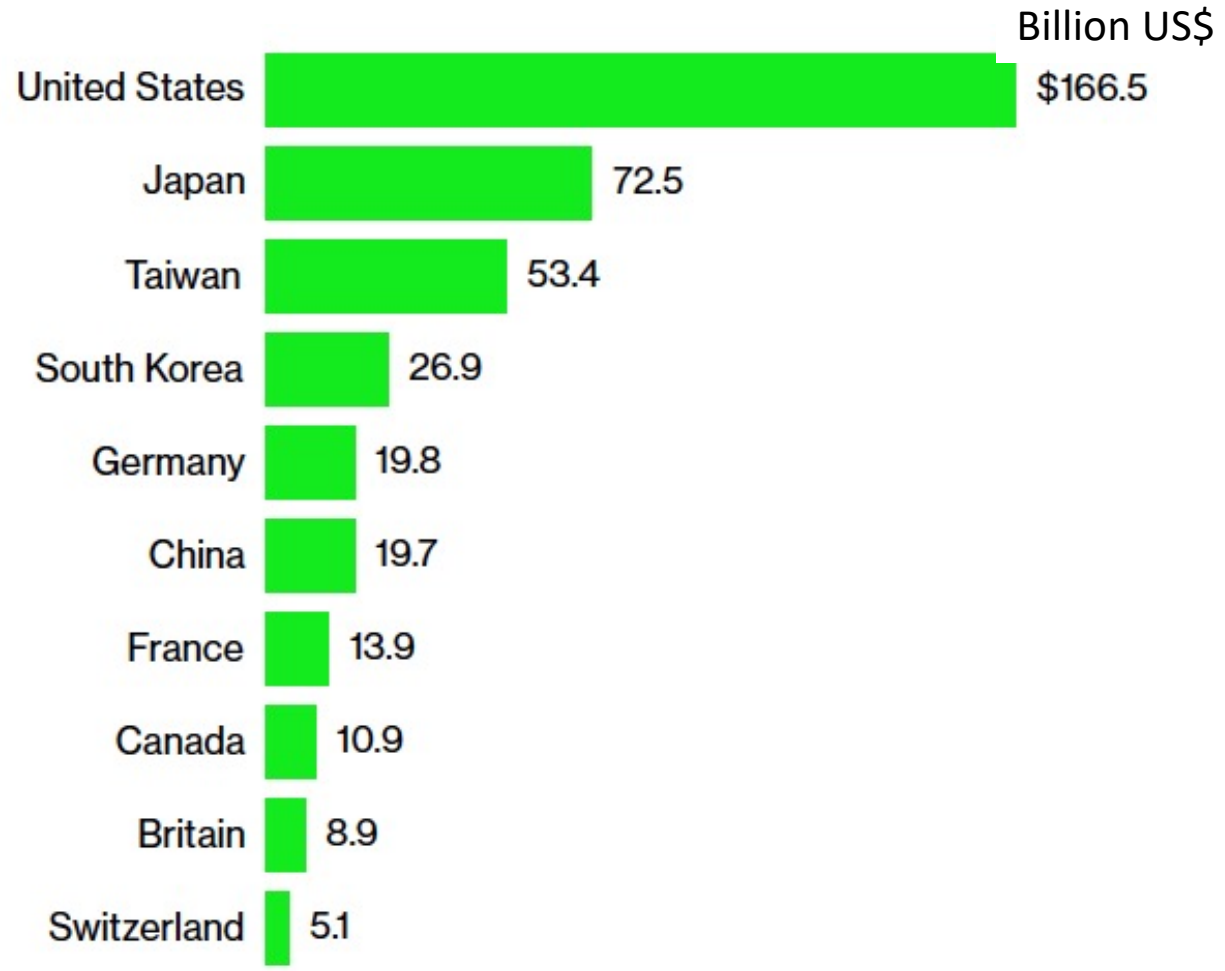


Source: BloombergNEF, Bloomberg Terminal
Note: Chart is based on data available on Bloomberg's SPLC function, and does not necessarily represent the entire supply chain for this group of selected companies.

Source：BloombergNEF, 2020

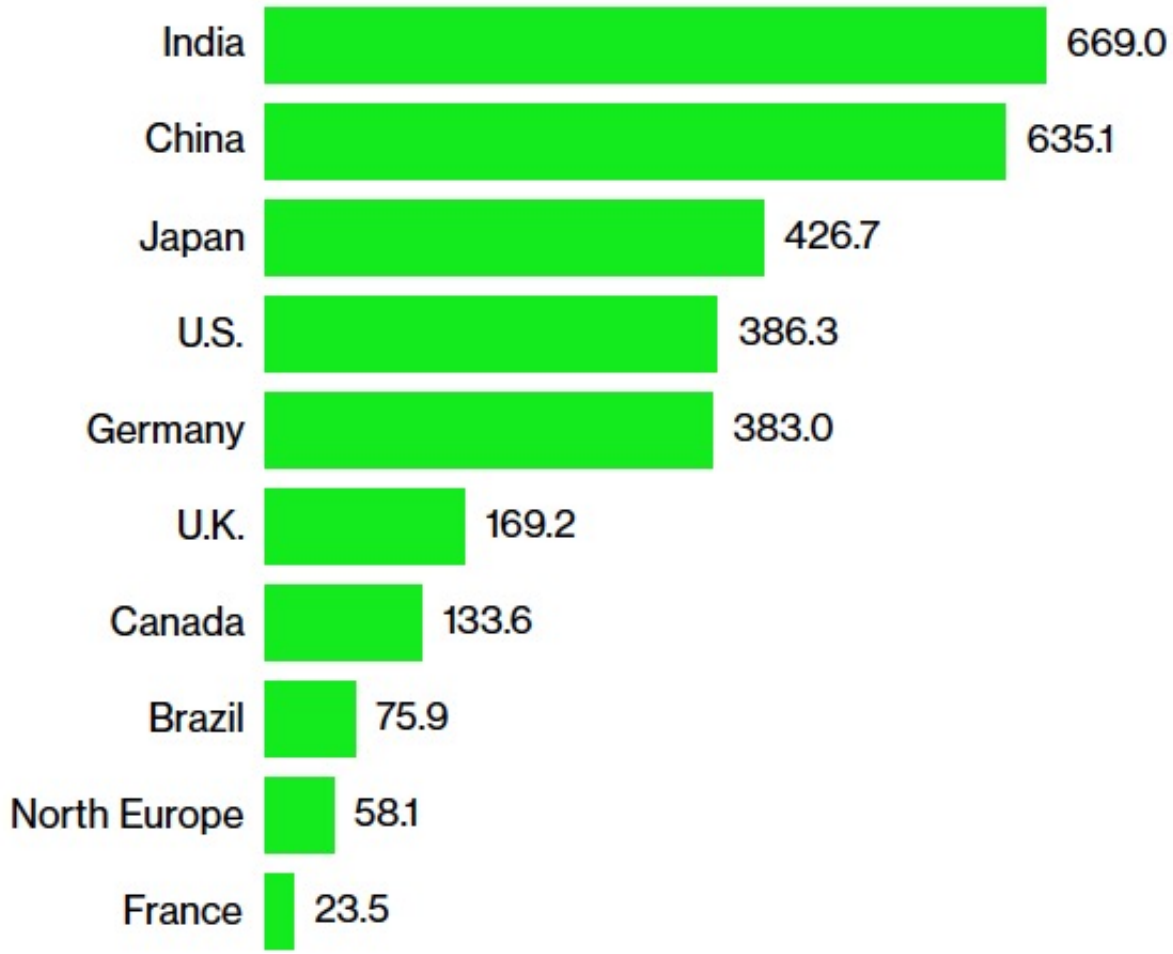
Business risk due to difficulty in procuring renewable energy

Japan is the country with the second highest business risk after the US.



Source : BloombergNEF, 2020

Emission intensity of electricity (2020)
（grams CO2/kWh）



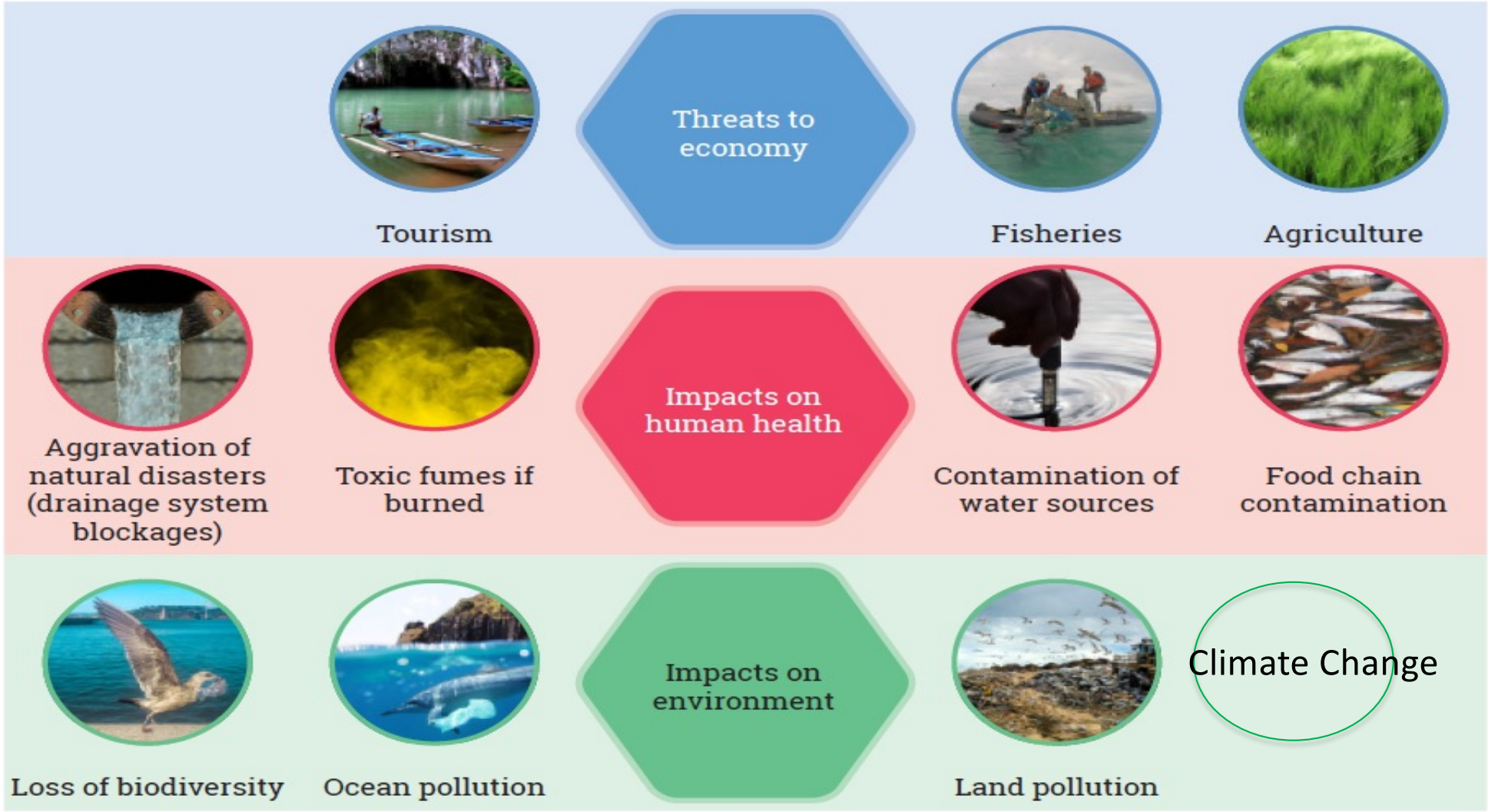
Source：BloombergNEF, 2020

“Sony warns it could move factories over Japanese energy policy”

- Sony warns it could move factories over Japanese energy policy (Financial Times, 27 Nov. 2020)
  - “So they told me either we do something about renewables or they have to move out of Japan.” (Minister Kono (at that time))

https://www.ft.com/content/bbd59494-ac64-4dda-8da5-a2990d8936d3

Impact of unsound management of plastics



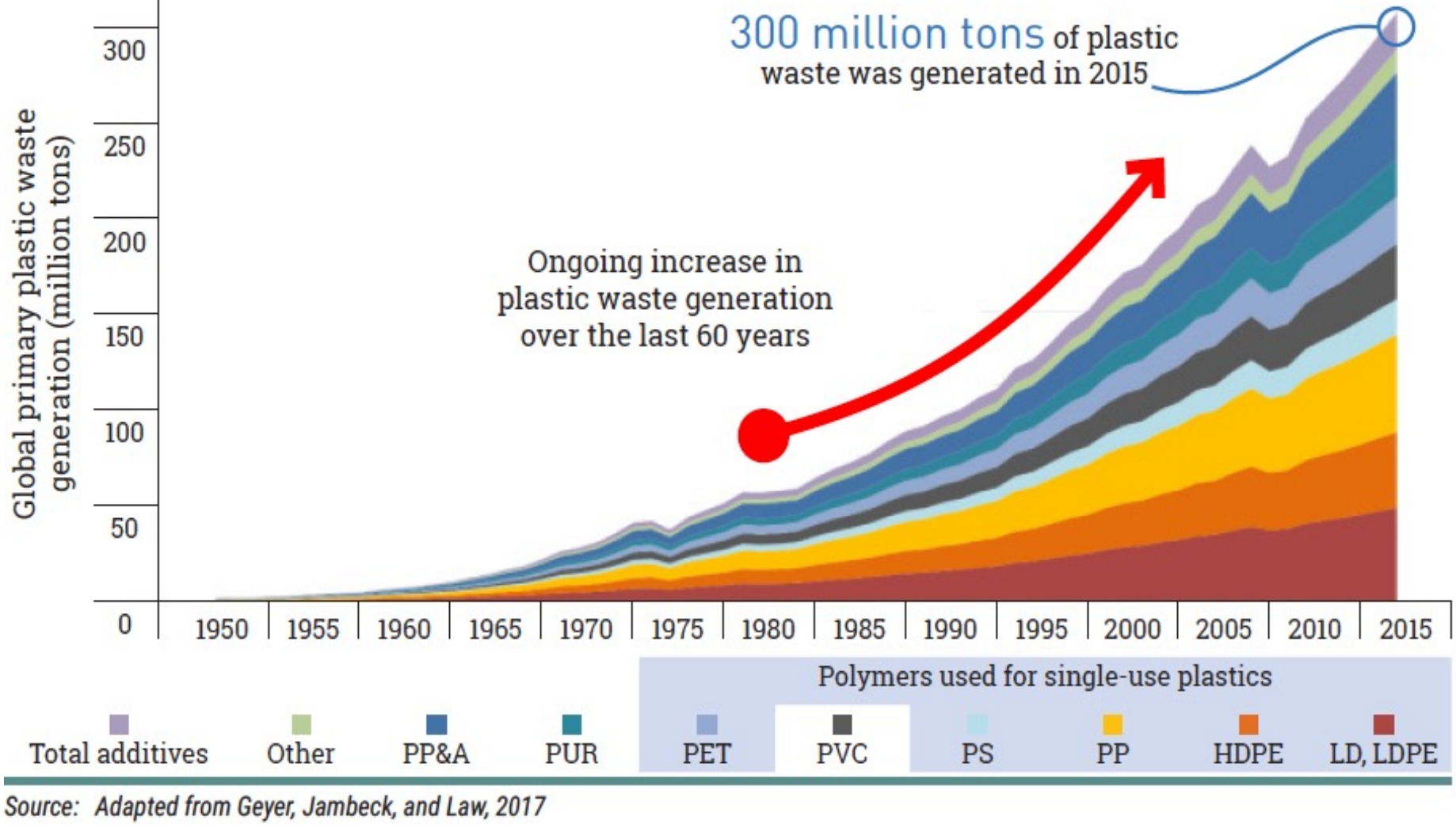
- Unsound management of plastic wastes impacts on the environment including climate and ecosystem.
- Wasting ecomic values of material especially through single-use
- Externalities: Asia-Pacific Economic Cooperation (APEC) estimates that the cost of ocean plastics to the tourism, fishing and shipping industries was USD 1.3 billion in that region alone.
- Linkage between circular economy, climate and nature.

Plastic production

- Since the 1950s, growth in the production of plastic has largely outpaced that of any other material.
- The world produces more than 400 million tons of plastics every year.
- If the growth in plastic production continues at the current rate, by 2050 the plastic industry may account for 20% of the world's total oil consumption.

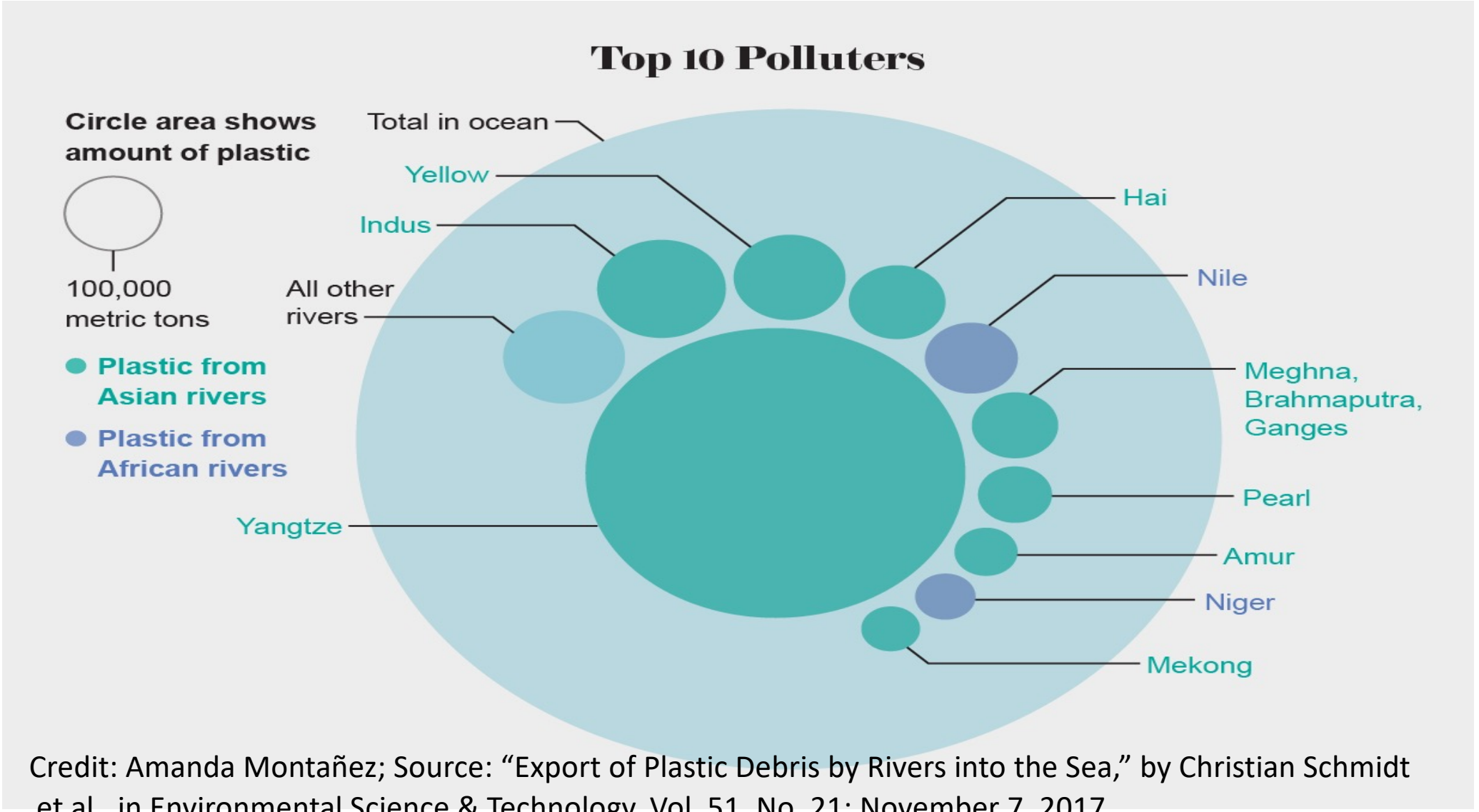
Global primary plastics waste generation, 1950-2015

In 2015, packaging waste accounted for 47% of the plastic waste generated globally, with half of that appearing to come from Asia.



Source: Adapted from Geyer, Jambeck, and Law, 2017

Top 10 polluters



Credit: Amanda Montañez; Source: "Export of Plastic Debris by Rivers into the Sea," by Christian Schmidt et al., in Environmental Science & Technology, Vol. 51, No. 21; November 7, 2017

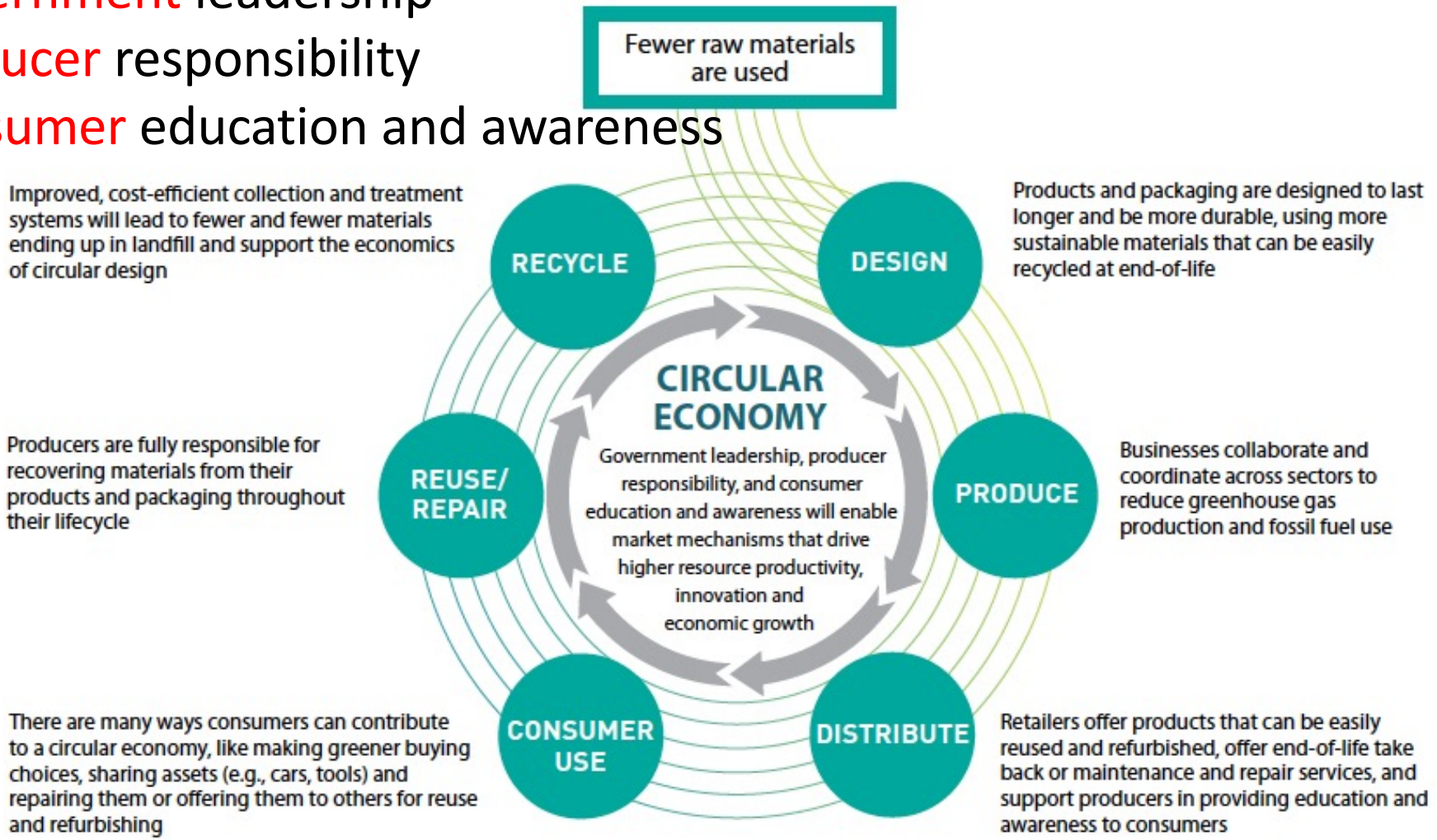
Circular Economy

A linear « make-use-dispose » process to « circular economy »

Government leadership

Producer responsibility

Consumer education and awareness



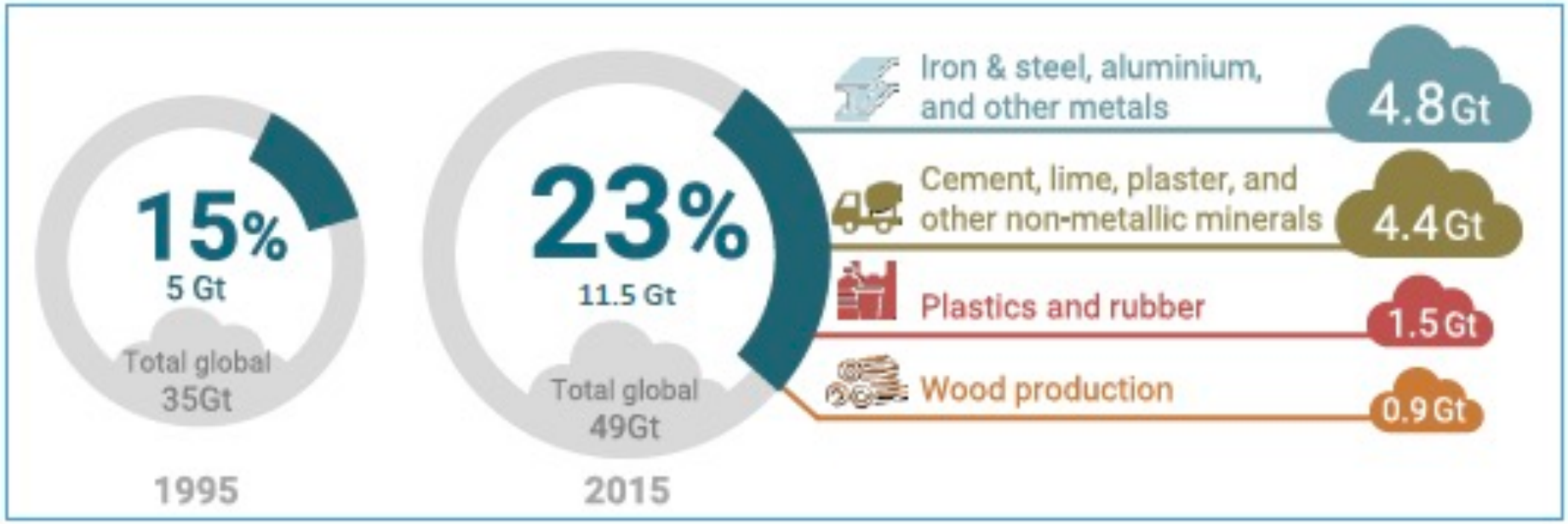
Source: Takamura, based on Strategy for a Waste-Free Ontario: Building the Circular Economy

Why Build a Circular Economy?

- What is « Circular Economy »?
  - an economy in which participants strive,
    - (a) to minimize the use of raw materials,
    - (b) to maximize the useful life of materials and other resources through resource recovery, and
    - (c) to minimize waste generated at the end of life of products and packaging.
- Why Build a « Circular Economy»?
  - A Circular Economy will
    - Protect the environment;
    - Help businesses stay competitive;
    - Drive innovation.

Source: Takamura, based on Strategy for a Waste-Free Ontario: Building the Circular Economy

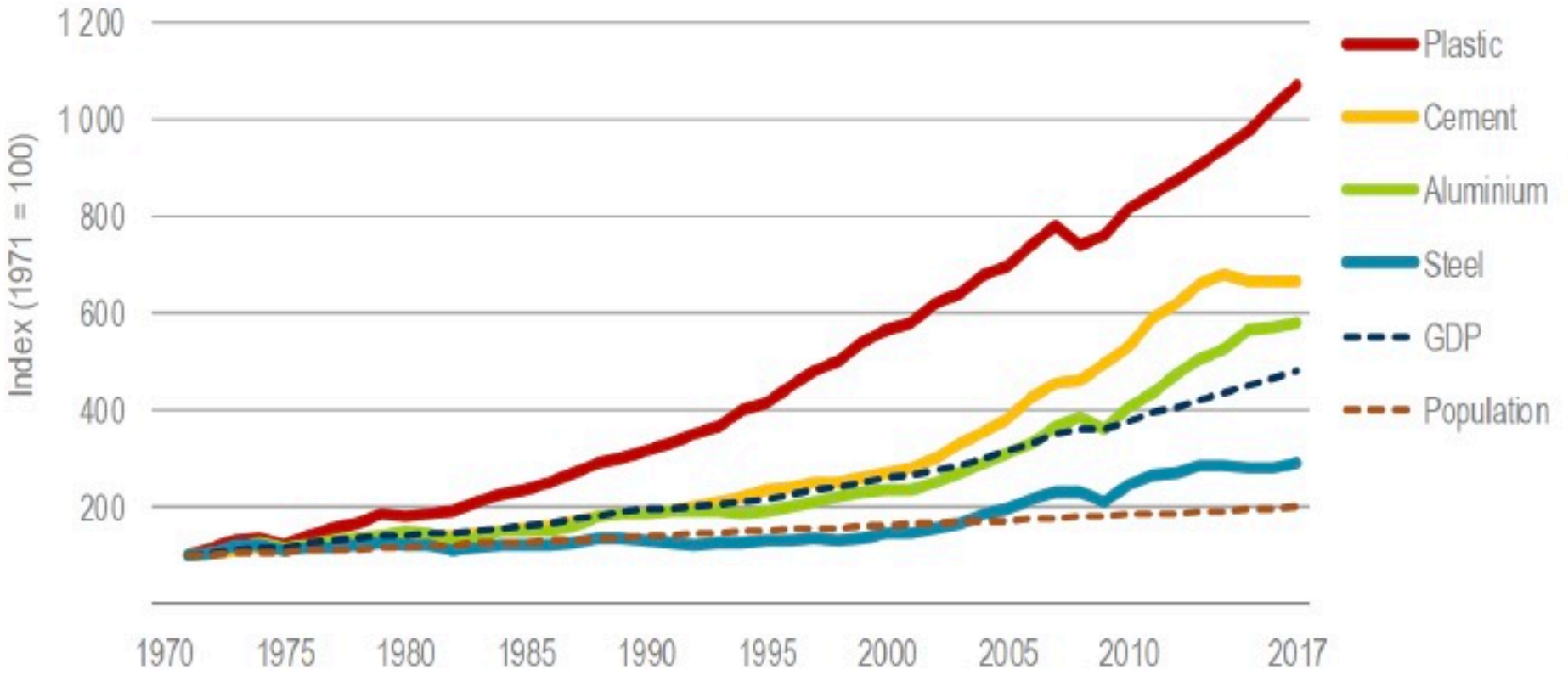
Emissions caused by material production as a share of total global emission （1995 v. 2015）



Source：Hertwich et al., Resource Efficiency and Climate Change (2020)

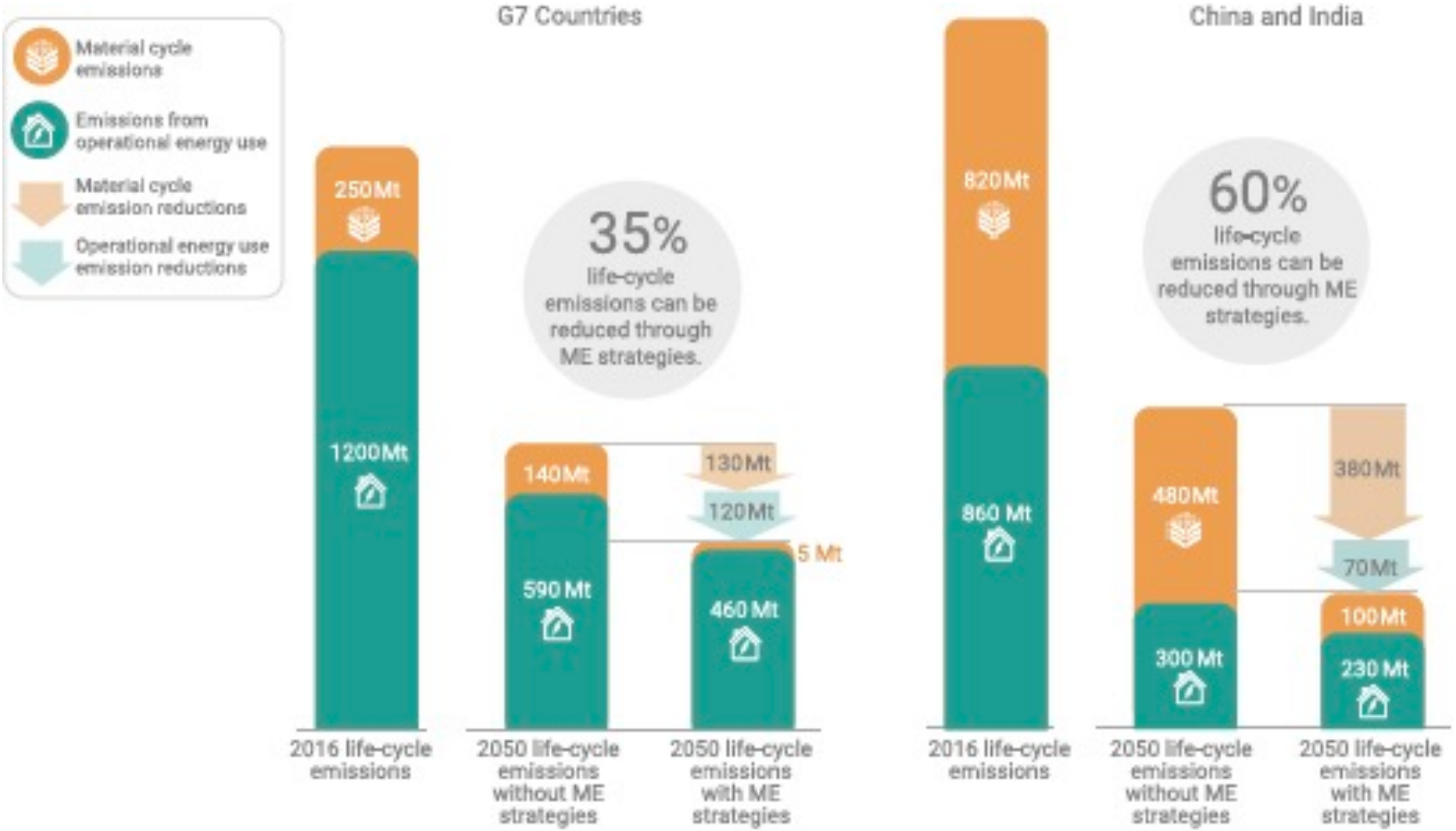
Demand for materials increases.

Since 1971, demand for steel has tripled.
About 7 times for cement, nearly 6 times for aluminum, more than 10 times for plastic.
Population increase and GDP growth are drivers.



Source：Hertwich et al., Resource Efficiency and Climate Change (2020)

Lifecycle emissions from home with and without material efficiency strategies in 2050



Source：Hertwich et al., Resource Efficiency and Climate Change (2020)

Material Efficiency Strategies for Housing and Policy Options

- Using less material by design
- Material substitution
  - Ex. By timber wood
- Fabrication yield improvement
- More intensive use
- Enhanced end-of-life recovery and recycling of materials
- Reuse of materials and components
- Product lifetime extension

Design

Manufacturing

Waste management

Use (users)

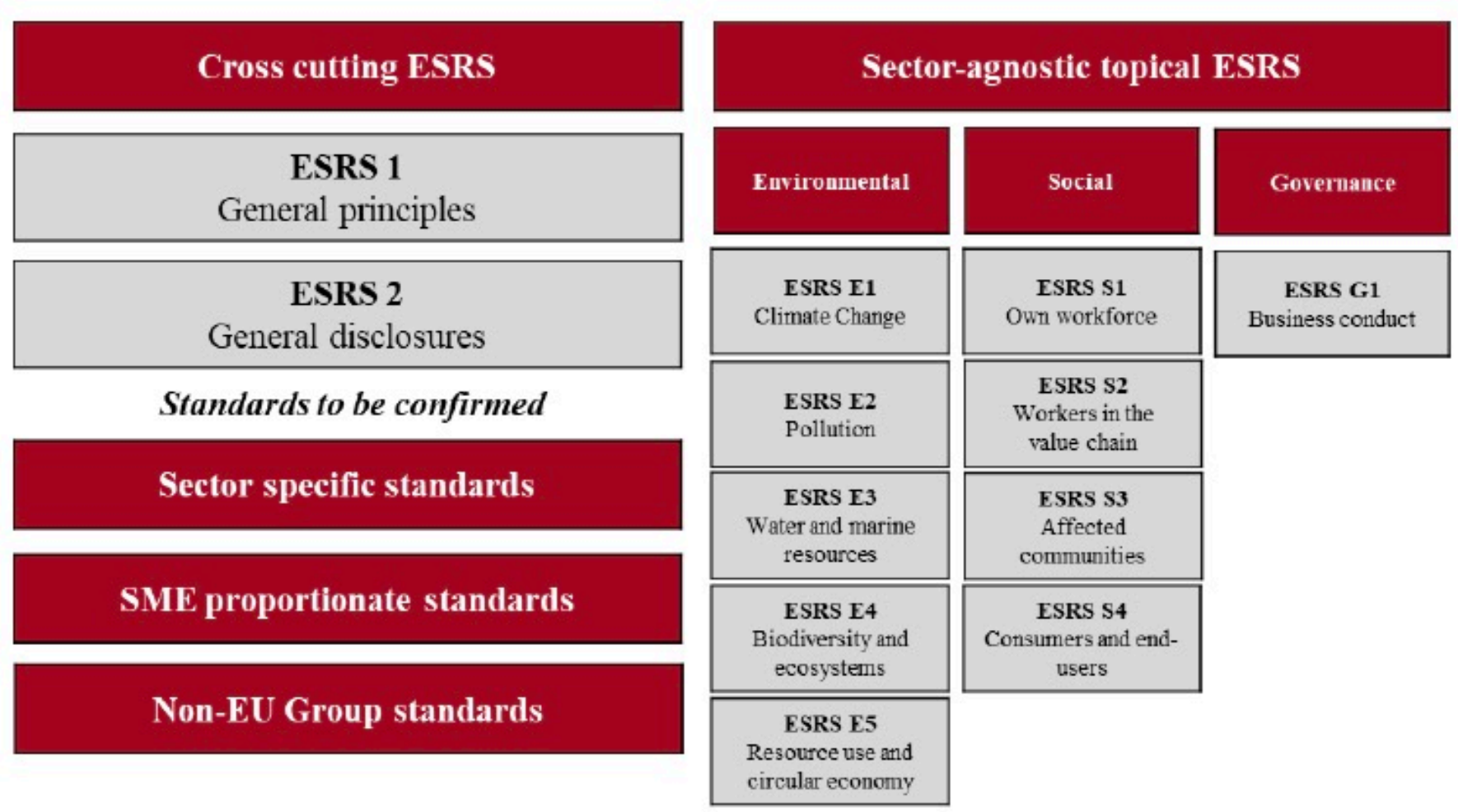
- In addition, for automobile, sharing and share ride

EU Corporate Sustainability Reporting

- Corporate Sustainability Reporting Directive (CSRD) (adopted in Dec. 2022, entry into force in Jan. 2023)
  - Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting
- ESRS (European Sustainability Reporting Standards)
  - Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards (adopted in July 2023)

- Corporate Sustainability Due Diligence Directive/CS3D: draft adopted by European Parliament in June 2023

European Sustainability Reporting Standard（ESRS）



Why cities are so important in tackling climate change

- Cities and cities' population (especially vulnerable), present and future, are most impacted by climate crisis.
- Cities are significant contributors to climate change
  - Cities host more than half of the global population, 4.4 billion inhabitants, and this urban population is projected to double by 2050.
  - Due to this population density, cities also account for over 80% of GDP. Cities are responsible for about 60% of global GHG emissions and for about 75% of global natural resource consumption.
- Cities possess the expertise and capacity to deliver climate-related policies, actions and projects and are also hubs for innovations and good practices.

Importance of actions by urban areas（IPCC AR6, 2022）

- Urban areas can create opportunities to increase resource efficiency and significantly reduce GHG emissions through the systemic transition of infrastructure and urban form through low-emission development pathways towards net-zero emissions.
- Ambitious mitigation efforts for established, rapidly growing and emerging cities will encompass
  - 1) reducing or changing energy and material consumption,
  - 2) electrification, and
  - 3) enhancing carbon uptake and storage in the urban environment.
- Cities can achieve net-zero emissions, but only if emissions are reduced within and outside of their administrative boundaries through supply chains, which will have beneficial cascading effects across other sectors.

Climate Resilient Development (CRD) in the IPCC AR6 (1)

- "climate resilient development"
  - "the process of implementing greenhouse gas mitigation and adaptation measures to support sustainable development for all." (IPCC AR6 WG2 SPM)
  - "…integrates adaptation and GHG mitigation to advance sustainable development for all." (IPCC AR6 Synthesis Report)
  - "Pursuing these goals in an integrated manner increases their effectiveness in enhancing human and ecological well-being. Climate resilient development can help build capacity for climate action, including contributing to reductions in greenhouse gas emissions, while enabling the implementation of adaptation options that enhance social, economic and ecological resilience to climate change as the prospect of crossing the 1.5℃ global warming level in the early 2030s approaches."

  - "integration" "enhancing human and ecological well-being"

- Urban systems are critical.
  - "Urban systems are critical for achieving deep emissions reductions and advancing climate resilient development, particularly when this involves integrated planning that incorporates physical, natural and social infrastructure."

Climate Resilient Development (CRD)(2)

- Certain temperature rise will make CRD impossible/ harder.
  - "CRD will not be possible in some regions and sub-regions if global warming exceeds 2℃".
- Rapid decline of GHG emission is needed for CRD.
  - "Climate resilient development prospects are increasingly limited if current greenhouse gas emissions do not rapidly decline, especially if 1.5℃ global warming is exceeded in the near-term."

- Safeguarding biodiversity and ecosystem is fundamental to CRD.
  - "Safeguarding biodiversity and ecosystems is fundamental to climate resilient development, but biodiversity and ecosystem services have limited capacity to adapt to increasing global warming levels, making climate resilient development progressively harder to achieve beyond 1.5℃ warming."

Climate Resilient Development (CRD)(3)

- Effective and equitable adaptation and mitigation in development planning
  - "Embedding effective and equitable adaptation and mitigation in development planning can reduce vulnerability, conserve and restore ecosystems, and enable climate resilient development."

- Actions that prioritise equity, climate justice, social justice and inclusion advance CRD
  - "Actions that prioritise equity, climate justice, social justice and inclusion lead to more sustainable outcomes, co-benefits, reduce trade-offs, support transformative change and advance climate resilient development. "

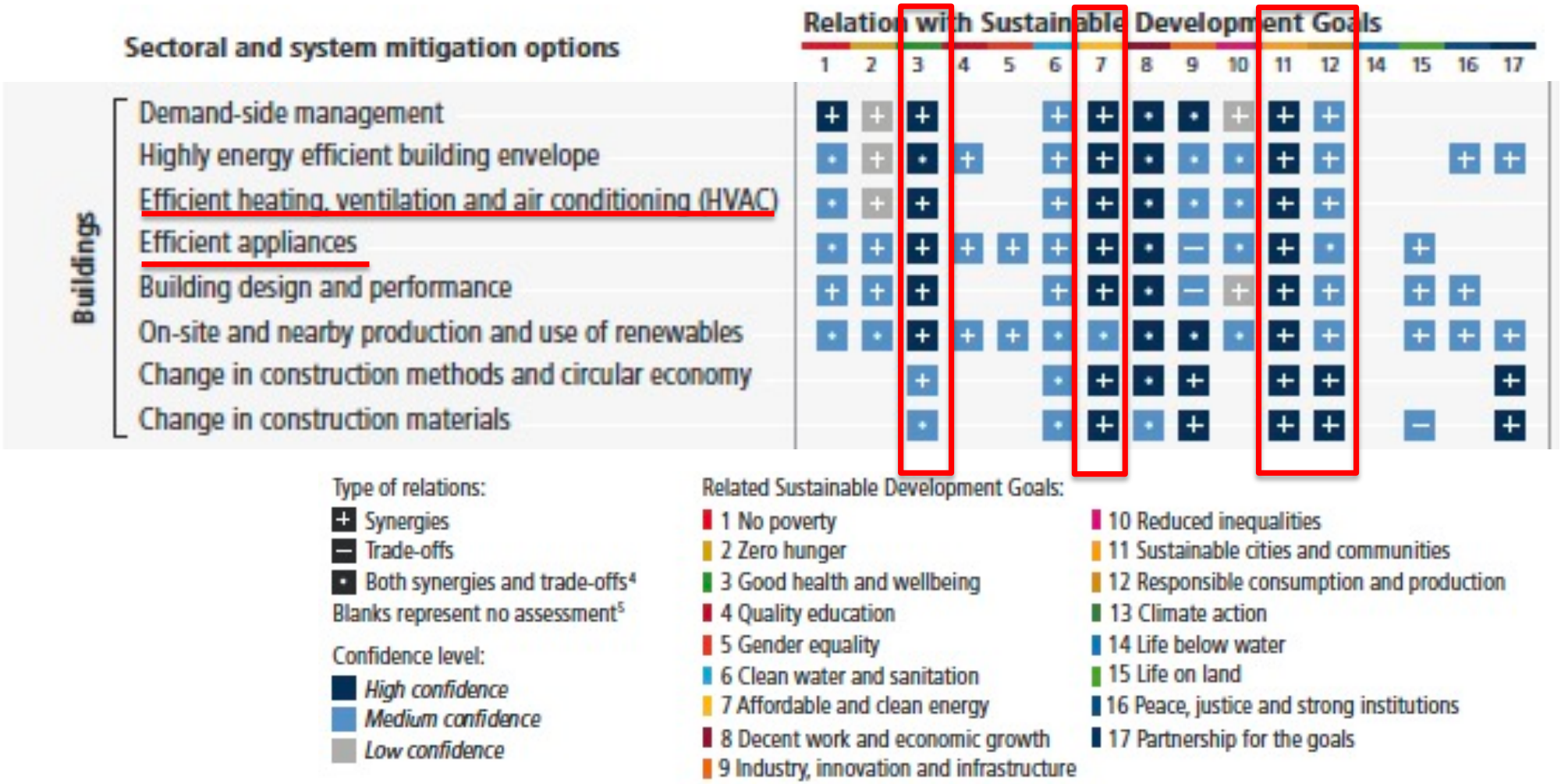
- Interacting choices and actions by government, private sector and civil society actors: involvement of and interaction among multi-stakeholder. Drawing on their diverse knowledge
  - "interacting choices and actions made by diverse government, private sector and civil society actors can advance climate resilient development, shift pathways towards sustainability, and enable lower emissions and adaptation. "
  - "Drawing on diverse knowledge and partnerships, including with women, youth, Indigenous Peoples, local communities, and ethnic minorities can facilitate climate resilient development and has allowed locally appropriate and socially acceptable solutions."

Climate Resilient Development (CRD)(4)

- CRD strategies that treat climate, ecosystems and biodiversity, and human society as parts of an integrated system. Policy integration. Synergies and progress towards SDGs.
  - "Climate resilient development strategies that treat climate, ecosystems and biodiversity, and human society as parts of an integrated system are the most effective."
  - "Climate resilient development is enabled when decision-making processes and actions are integrated across sectors. Synergies with and progress towards the Sustainable Development Goals enhance prospects for climate resilient development."

- CRD enabled by increased international cooperation including improved access to financial resources.
  - "Climate resilient development is enabled by increased international cooperation including improved access to financial resources, particularly for vulnerable regions, sectors and groups, and inclusive governance and coordinated policies."

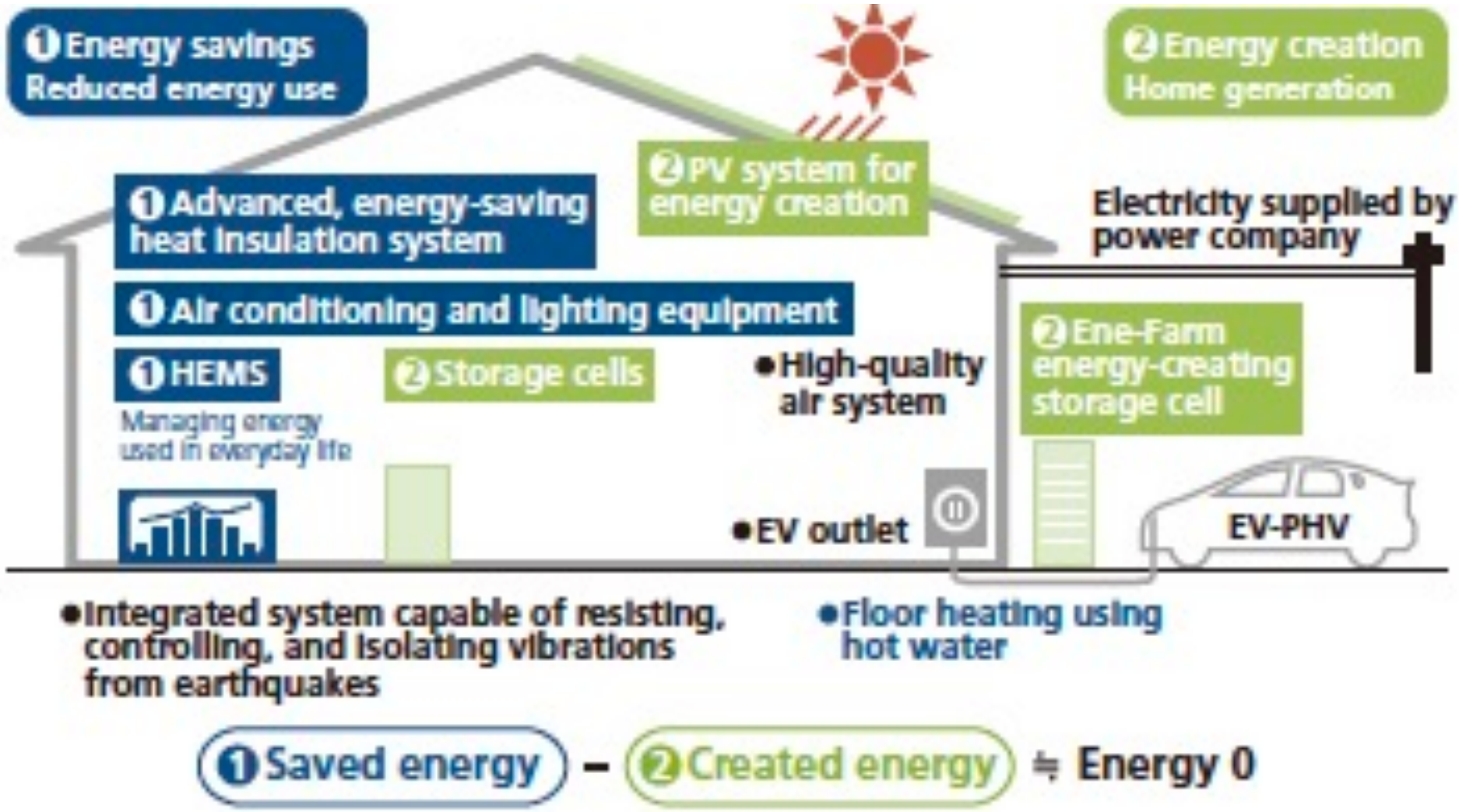
Synergies between mitigation in the buildings and SDGs



HEALTH, energy, cities

Source: IPCC AR6 WG3, 2022

ZEH/ZEB


❶ Energy savings
Reduced energy use
❷ Energy creation
Home generation
❷ PV system for energy creation
❶ Advanced, energy-saving heat insulation system
Electricity supplied by power company
❶ Air conditioning and lighting equipment
❶ HEMS
Managing energy used in everyday life
❷ Storage cells
● High-quality air system
❷ Ene-Farm energy-creating storage cell
● EV outlet
EV-PHV
● Integrated system capable of resisting, controlling, and isolating vibrations from earthquakes
● Floor heating using hot water
❶ Saved energy – ❷ Created energy ≒ Energy 0

Mitigation combining sufficiency, efficiency and renewables contributes to achieving SDGs.

- "In modelled global scenarios, existing buildings, if retrofitted, and buildings yet to be built, are projected to approach net zero GHG emissions in 2050 if policy packages, which combine ambitious sufficiency, efficiency, and renewable energy measures, are effectively implemented and barriers to decarbonisation are removed. Low ambition policies increase the risk of locking-in buildings' carbon for decades, while well-designed and effectively implemented mitigation interventions...have significant potential to contribute to achieving SDGs in all regions while adapting buildings to future climate."

Source: IPCC AR6 WG3, 2022

Towards resilient and sustainable cities (1)

- Global community is now heading for the 1.5℃ goal. Years to 2030 are "critical decade" "decisive decade" to mitigate impacts of climate change in future.

- Needs scale up and speed up of transformation and systems transition with investment. What we do now determines future.

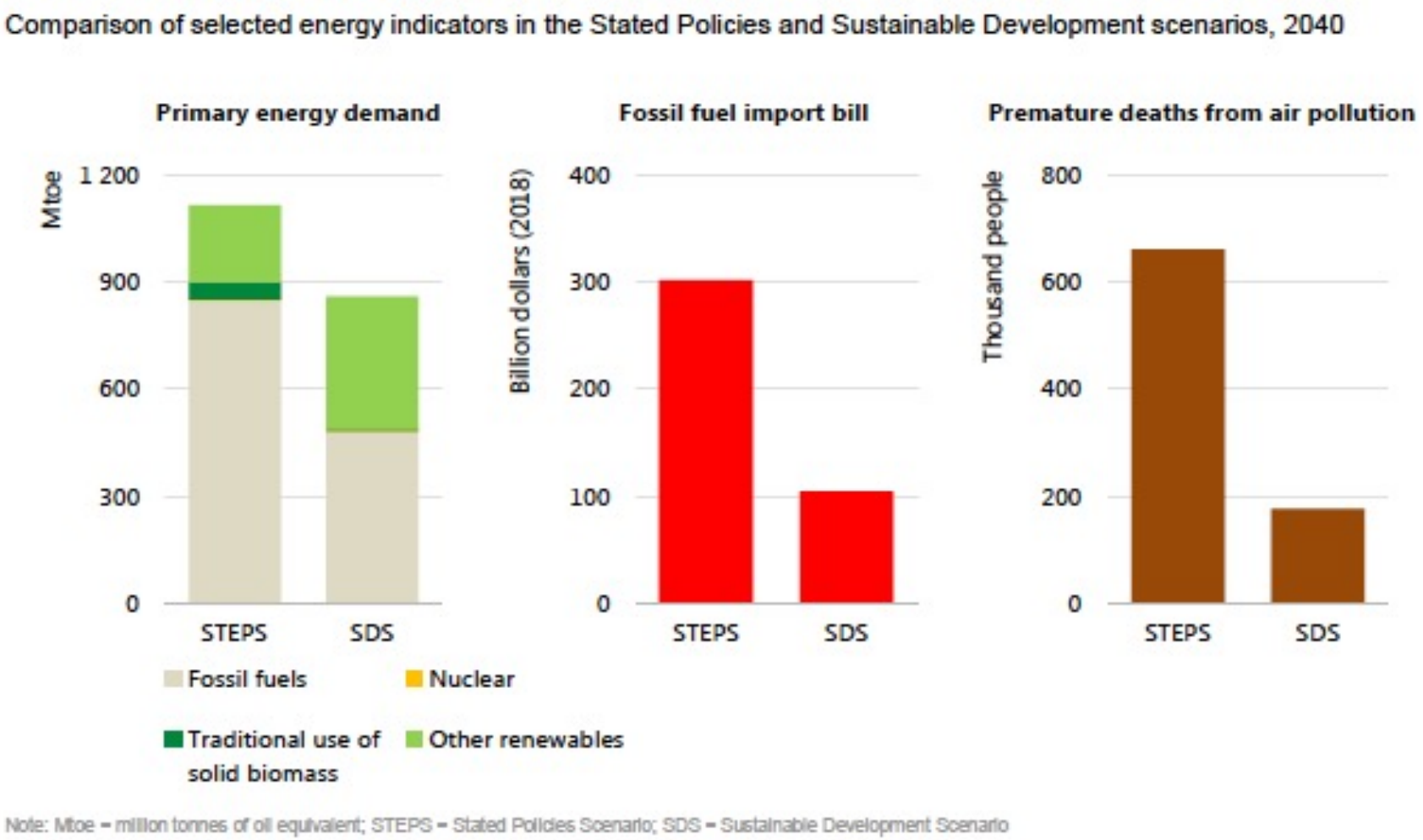
- "Urban systems are critical for achieving deep emissions reductions and advancing climate resilient development" (IPCC WG2, 2022)
  - Cities are significant contributors to climate change.
  - Cities are the hubs for creating solution and innovation.
  - Cities then can impact and reduce emission within and outside cities.

  - " Urban systems are critical for achieving deep emissions reductions and advancing climate resilient development, particularly when this involves integrated planning that incorporates physical, natural and social infrastructure." (IPCC WG2, 2022)

Towards resilient and sustainable cities (2)

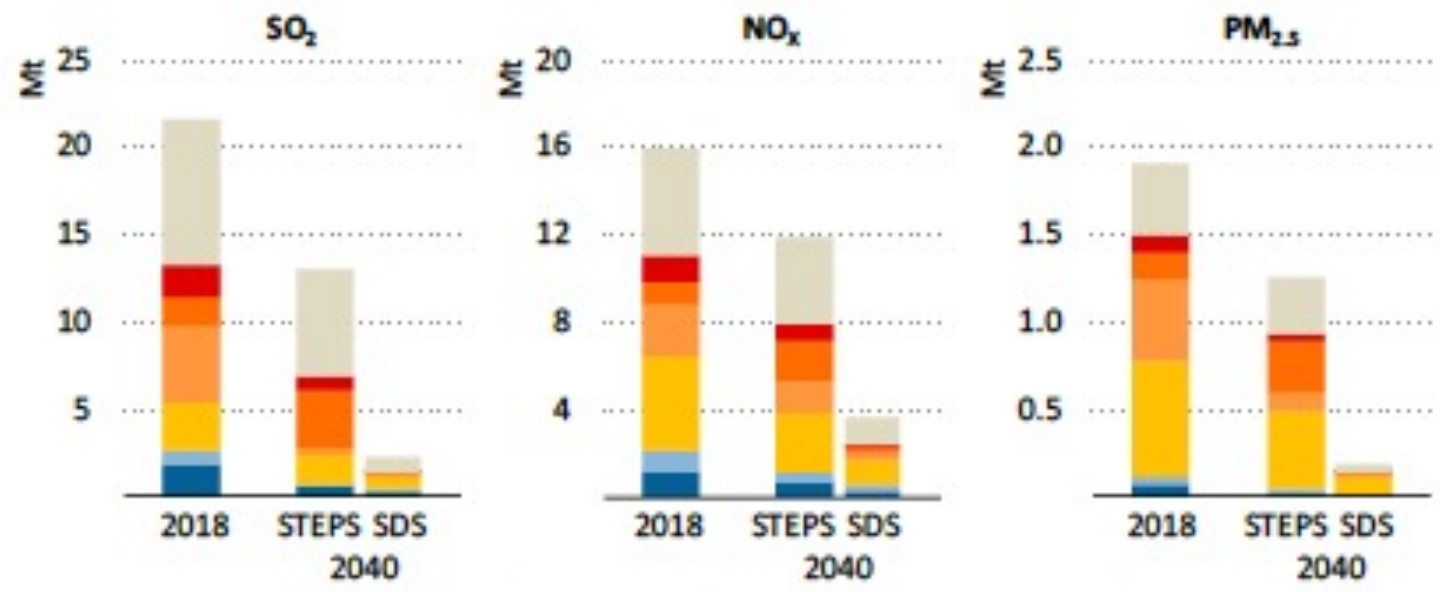
- Discover, recognize and enhance synergies and multiple benefits (co-benefits) of transition.
  - In addition to reducing GHGs, lowering energy cost, expanding new market, promoting resource efficiency, producing new employment, improving health, enhancing resilience…
  - Integration of mitigation and adaptation (climate resilient development)
  - Especially, in face of energy crisis
    - Improvement in energy efficiency and renewable energy introduction has immediate impacts on energy cost of households and of companies.
    - Enhance energy security, mitigate trade deficit…
  - Especially important for businesses, because it will
    - Improve competitiveness and resilience through cost efficiency and resource efficiency
    - Create new markets and businesses. Co-innovation
    - Enhance corporate value in the financial market and in supply chain
    - Good opportunities for inducing private investment
    - Cities could attract businesses seeking to decarbonize its business and supply chain.

Multiple benefits of SD Scenario



Source：IEA, 2019

Energy transition will enhance reduction of air pollution



Pollutant emissions from the power sector, mainly driven by coal use in Asia, are projected to reduce by 2040, most significantly in the Sustainable Development Scenario, where end-of-pipe technologies and lower fossil fuel use drive the change

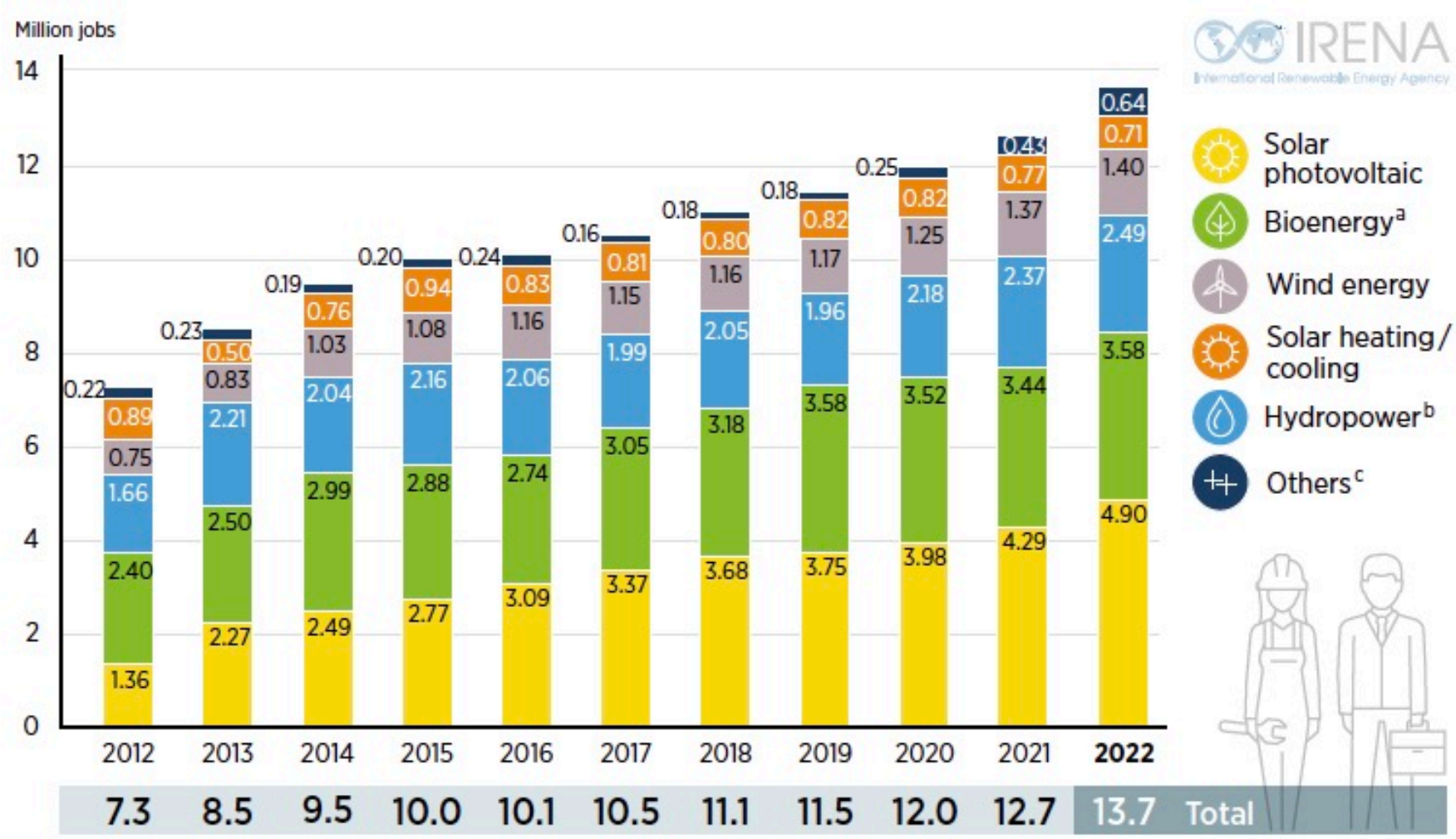
Note: Mt = million tonnes; STEPS = Stated Policies Scenario; SDS = Sustainable Development Scenario.

Source: International Institute for Applied Systems Analysis.

Source : IEA, 2019

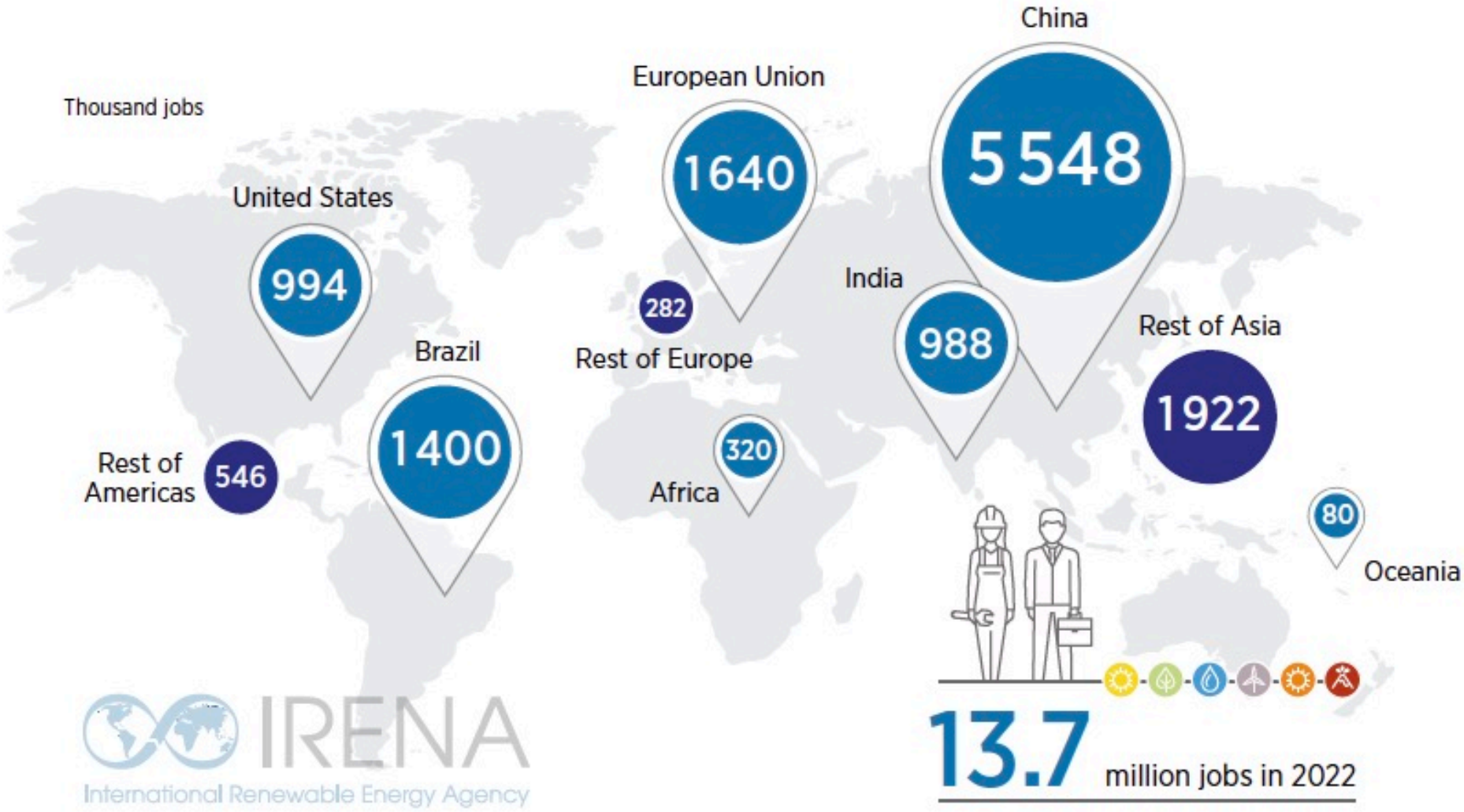
Trends in renewable energy employment (2012 - 2022)

RE jobs have doubled from 7.3 million in 2012 to 13.7 million in 2022.



Source : IRENA, 2023

Renewable energy employment



Disclaimer: This map is provided for illustration purposes only. Any boundaries and names shown do not imply any endorsement or acceptance by IRENA.

Source: IRENA 2024

Towards resilient and sustainable cities (3)

- Systemic transition of infrastructure for climate resilient development
  - integrated planning that incorporates physical, natural and social infrastructure
- Emissions should be reduced within and outside of their administrative boundaries through supply chains
- Life cycle environmental and social impact, including material efficiency
- Transform energy system, starting with power sector.
  - Net zero emission infrastructure, starting with homes (ZEH) and buildings (ZEB)
  - Towards energy system with more distributed and interlinked energy sources including EV and buildings.
  - Energy system integration : How to integrate variable renewable into the grid? How to ensure and increase flexibility of power system, in a decarbonized and cost- effective ways? Demand and Response (DR)
  - Enhancing carbon uptake and storage in the urban environment. Ex Use of wood products in the cities
- Collaboration among a variety of policy and technology areas and disciplines.
  - Urban infrastructure is composite of plenty of technologies and its application.

Towards resilient and sustainable cities (4)

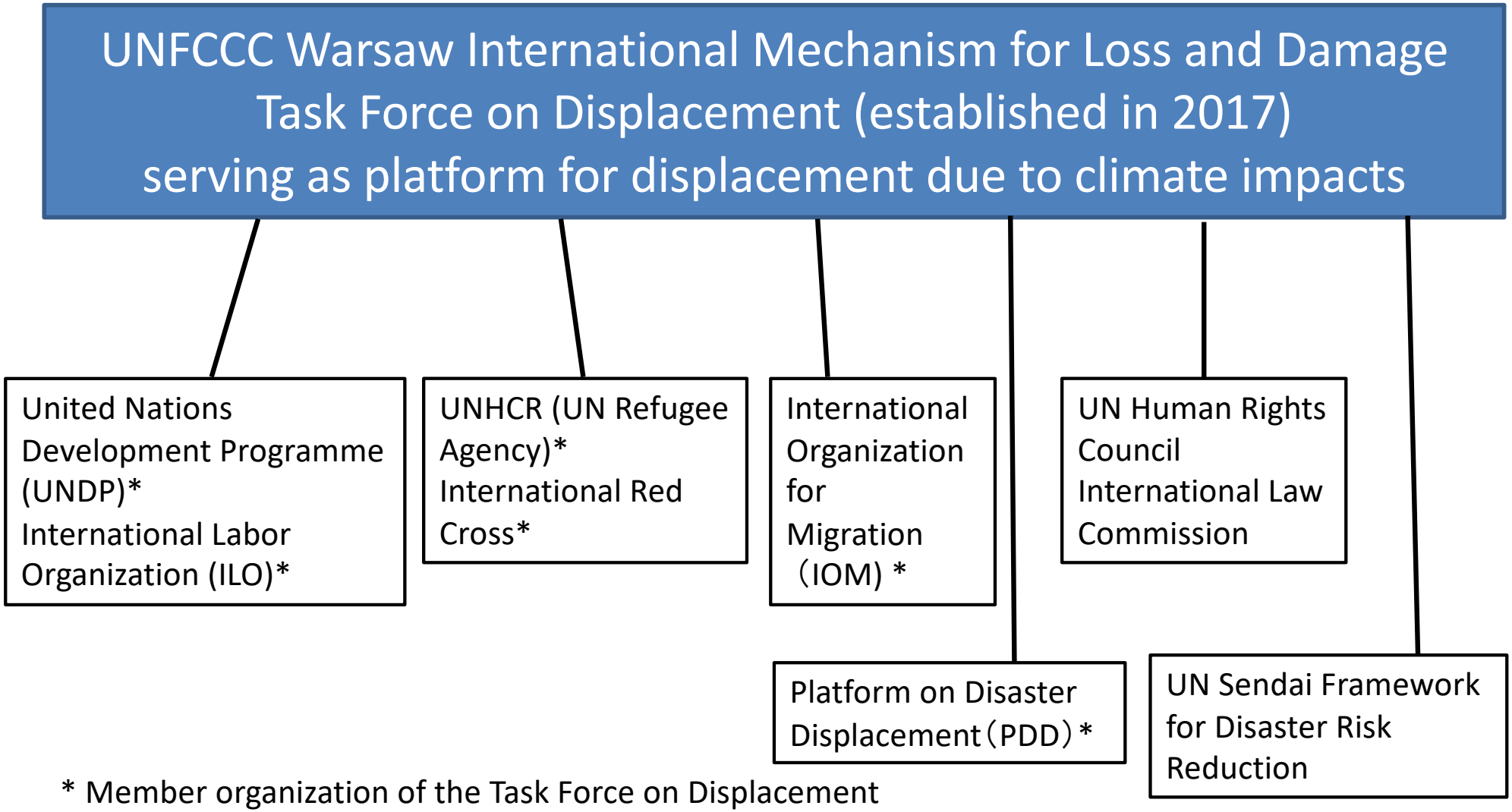
- Actions that prioritise equity, climate justice, social justice and inclusion advance CRD
  - "Actions that prioritise equity, climate justice, social justice and inclusion lead to more sustainable outcomes, co-benefits, reduce trade-offs, support transformative change and advance climate resilient development. "

- Interacting choices and actions by government, private sector and civil society actors: involvement of and interaction among multi-stakeholder. Participatory approach. Drawing on their diverse knowledge
  - "interacting choices and actions made by diverse government, private sector and civil society actors can advance climate resilient development, shift pathways towards sustainability, and enable lower emissions and adaptation. "
  - "Drawing on diverse knowledge and partnerships, including with women, youth, Indigenous Peoples, local communities, and ethnic minorities can facilitate climate resilient development and has allowed locally appropriate and socially acceptable solutions."

Potential areas for co-operation

- Appropriate public policy is essential for "smooth systems transitions" = potential areas for cooperation
  - Prepare transitions and elaborate transitions strategies.
    - Integrate and mainstream climate consideration with long-term horizon (ex. 2050) in decision makings of all level (government, local authorities and companies, financial institutions, etc.).
  - Proceed to/ accelerate transitions while maximizing its benefits and managing its side effects.
    - Cooperation with private partners and multilateral financial institutions not only for these 3 countries but also for other countries, especially in Asia.
    - Ex. ADB led Energy Transition Mechanism to promote coal fired plants early retirement.
    - Protect the most vulnerable to transition. Labor policy, social policy interventions may be necessary.
  - Promoting and collaborate in decarbonizting supply chain/ value chain to enhance competitiveness of companies. Assisting companies to cope with "new normal".
    - Supply chain and value chain of companies expand over 3 countries. Efforts and collaboration for decarbonization will mutually enhance competitiveness of companies.
    - Small- and medium-sized companies, often lacking information/ capability necessary to cope with such request might be marginalized in global supply chain.
- Strengthen collaboration for enhancing resilience.
- Accumulating and exchanging experiences, good practices, role models, lessons learnt through inter-city cooperation.

UNFCCC and Paris Agreement as orchestrator



* Member organization of the Task Force on Displacement

Thank you for your attention!

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