



Trend
Compendium

2050

Six megatrends
that will shape the world



June 2023

The Roland Berger Trend Compendium 2050 focuses on stable, long-term developments ...

- > The **Roland Berger Trend Compendium 2050** is a global trend study compiled by **Roland Berger Institute (RBI)**, the think tank of Roland Berger. Our Trend Compendium 2050 describes the **most important megatrends** shaping the world between **now and 2050**
- > Our **trend views are based on expert sources and assessments**. Estimates reflect the normal case, i.e. a stable development of the global economy in the long term
- > To incorporate today's uncertainties into strategic planning, we recommend **combining the megatrends of the Roland Berger Trend Compendium 2050** with the **Roland Berger scenario planning approach**



2050

The graphic features the year '2050' in a large, bold, blue font. Below the text, there are several upward-pointing arrows of varying heights and widths, rendered in a light green color with a gradient. The arrows appear to be rising from a common base at the bottom, symbolizing growth and progress towards the year 2050.

Is it worth dealing with megatrends when globally impactful events such as the COVID-19 pandemic or the war in Ukraine are taking place?

Of course! The coronavirus pandemic and the war in Ukraine have far-reaching consequences and deeply affected people, economies and politics but neither event has derailed the megatrends analyzed herein; such is the inherent nature of megatrends: climate change, societal aging, or technological innovations do not lose their momentum, their direction or their importance. To cope with such challenges and to master resulting opportunities, our awareness and our understanding of megatrends is vital – not least to develop sustainable answers

... and covers six megatrends that shape the future development of our world to 2050

1

People & Society



Population
—
Migration
—
Education & Labor
—
Values

2

Politics & Governance



Global Risks
—
Geopolitics
—
Future of Democracy

3

Environment & Resources



Climate Change & Pollution
—
Biodiversity
—
Resources & Raw Materials

4

Economics & Business



Global Trade & Value Chains
—
Power Shifts
—
Energy Transformation
—
Debt Challenge

5

Technology & Innovation



Value of Innovation
—
Frontier Technologies
—
Humans & Machines

6

Health & Care



Global Health Challenges
—
Healthcare of the Future
—
Caregiving

Megatrend 1

People & Society



1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

Beyond mere demographics, people and society are at the core of our thinking – People are on the move, are eager to learn and rely on values

Subtrends of megatrend "People & Society"

1



Population

2



Migration

3



Education & Labor

4



Values

2 Politics & Governance

3 Environment & Resources

4 Economics & Business

5 Technology & Innovation

6 Health & Care

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

2 Politics & Governance

3 Environment & Resources

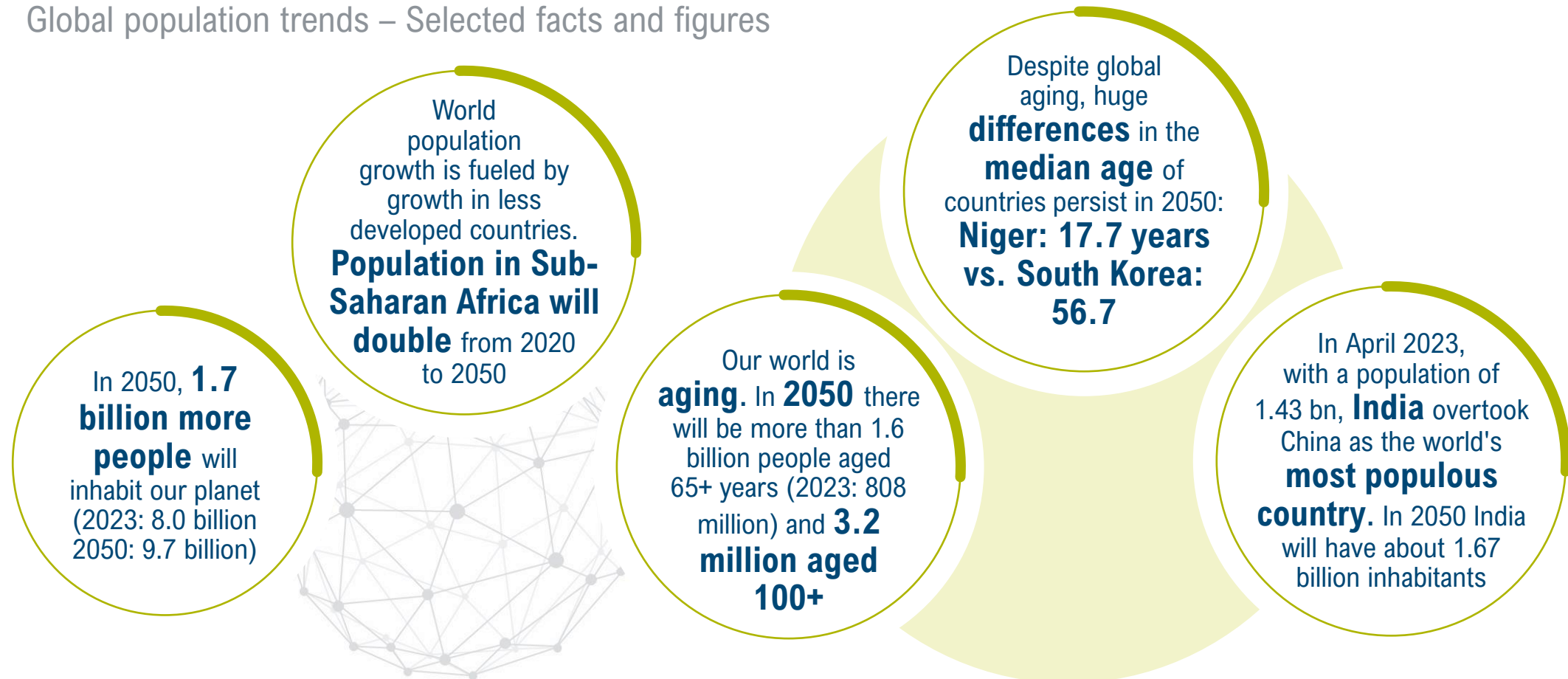
4 Economics & Business

5 Technology & Innovation

6 Health & Care

Population trends toward 2050 point to a myriad of changes worldwide for regions as well as countries, their growth rates and age structures

Global population trends – Selected facts and figures



Standing side by side, the **predicted 9.7 billion strong population of 2050 would span the equator more than 240 times**. However, average global population density will only rise to 74.5 people per sq km¹⁾ – around a quarter of the population density of the United Kingdom today

1) Calculation based on the Earth's land area excluding Antarctica
Sources: UN Population Division; UN Population Fund; UN; Roland Berger

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

2 Politics & Governance

3 Environment & Resources

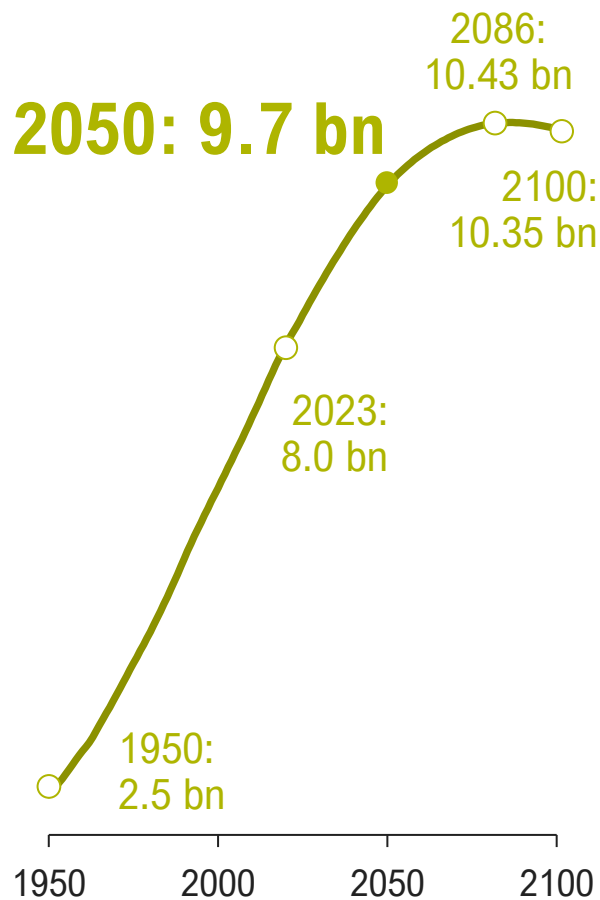
4 Economics & Business

5 Technology & Innovation

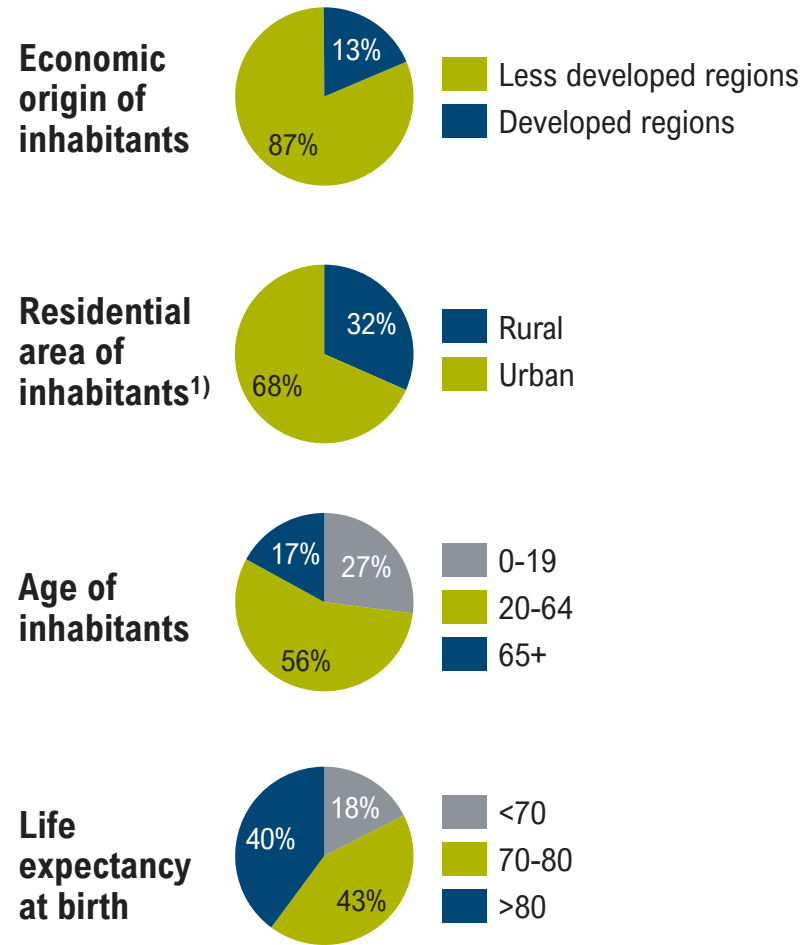
6 Health & Care

The population growth rate is decreasing due to lower fertility rates – In 2050, the vast majority of the 9.7 billion will live in less developed regions

Evolution of world population 1950-2100 [bn]



Global population characteristics 2050 [%]



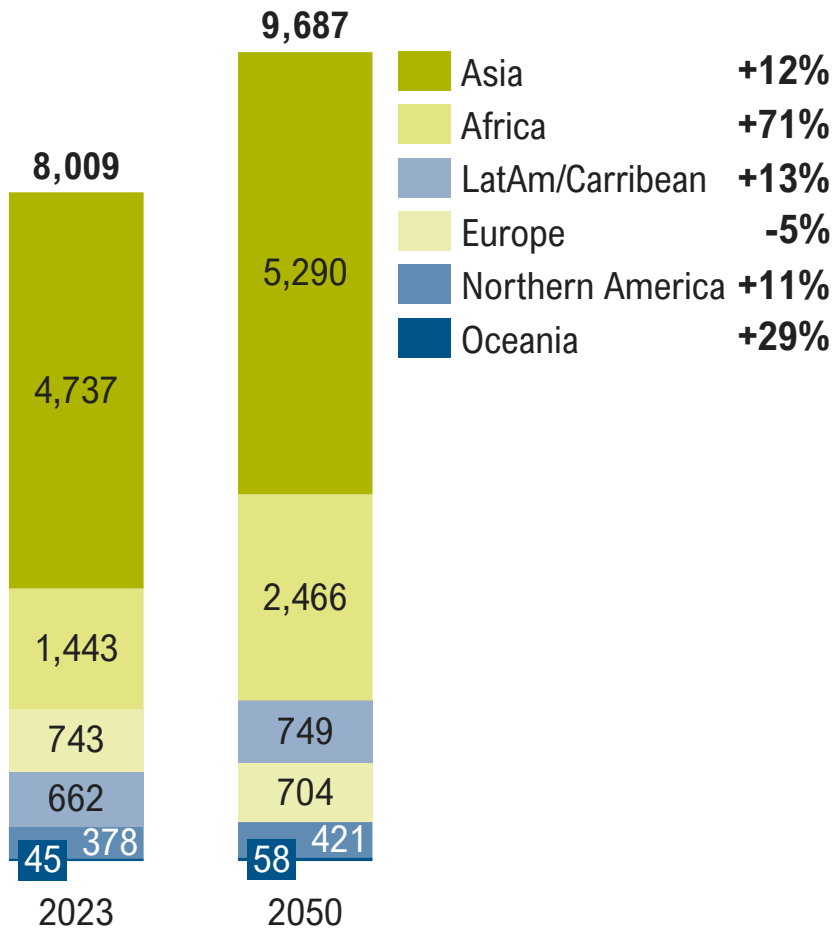
- > According to the UN medium variant prediction, the **world population will grow at a slower pace** between 2020 and 2050 compared to previous decades, reaching a population of **9.7 billion in 2050**
- > The **evolution of the world population is driven by two factors**: the evolution of fertility rates and the evolution of life expectancy
 - **Global fertility rates** are expected to **decrease** from 2.31 births per woman in 2023 to 2.15 births per woman in 2050. This lowers the rate of population growth
 - **Average life expectancy** is expected to **increase** from 73.4 years in 2023 to 77.2 years in 2050, globally. This drives population growth, but cannot totally compensate for decreasing fertility rates
- > In 2050, the **majority** of the global population will stem from **less developed regions**, resides in **urban areas**, is between **15 and 64 years old** and has a **life expectancy of more than 70 years**

1) The definition of urban areas follows the definitions that are used in each country
Sources: UN Population Division; Roland Berger

- ① People & Society
 - 1.1 Population
 - 1.2 Migration
 - 1.3 Education & Labor
 - 1.4 Values
- ② Politics & Governance
- ③ Environment & Resources
- ④ Economics & Business
- ⑤ Technology & Innovation
- ⑥ Health & Care

Over the next three decades, Africa's population will increase by more than 1 billion – Asia remains the world's population giant

Population by continent 2023 and 2050 and growth rates [m, %]



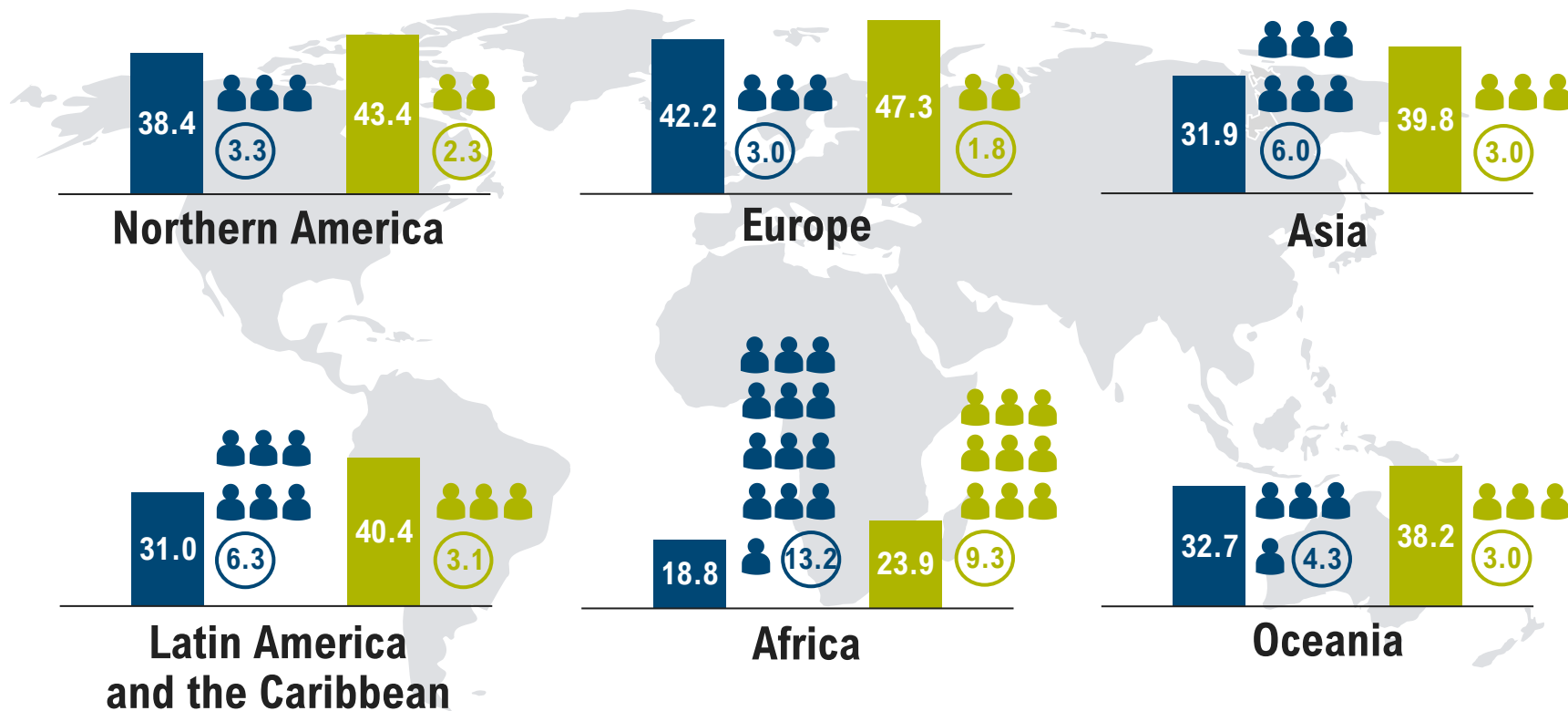
Top five countries per region by population 2050 [m]

Asia	India 1,670	China 1,313	Pakistan 368	Indonesia 317	Bangladesh 203
Africa	Nigeria 375	D.R. Congo 215	Ethiopia 213	Egypt 160	Tanzania 129
LatAm/Caribbean	Brazil 231	Mexico 144	Colombia 57	Argentina 52	Peru 42
Europe	Russia 134	Germany 79	UK 72	France 66	Italy 52
Northern America	USA 375	Canada 46	Bermuda <1	Greenland <1	S. Pierre & Miquelon <1
Oceania	Australia 32	Papua N. Guinea 15	New Zealand 6	Solomon Islands 1	Fiji 1

Sources: UN Population Division; Roland Berger

All regions are aging with fewer people of working age having to support more older people – Intercontinental differences remain significant

Median age [years] and old-age potential support ratio by region 2023 vs. 2050
 [number of working-age people (20-64 years old) / number of people 65+ years old]



Median age: 2023 2050 Old-age potential support ratio: 2023 2050

- > A low old-age potential support ratio can have severe consequences for countries where a large share of public expenditure is allocated, for example, to health, caregiving and social security, which is taken up by older members of society to a proportionally larger extent
- > However, there are several caveats: The old-age support ratio ignores the fact that people above the age of 65 are not necessarily dependent on support as a rising proportion is (still) in work or has access to other financial resources; also, by contrast, not all of those considered of working age are actually working

1 People & Society



1.1 Population



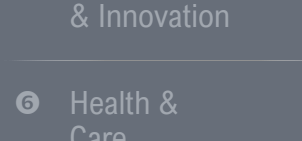
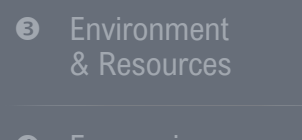
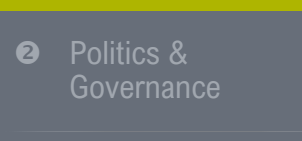
1.2 Migration



1.3 Education & Labor

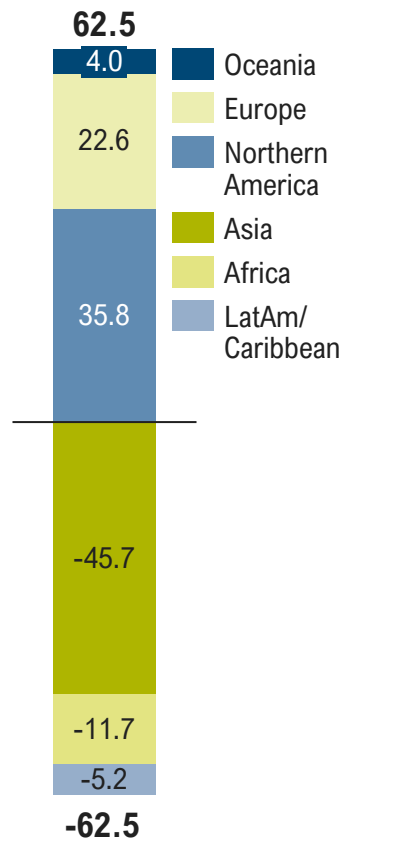


1.4 Values

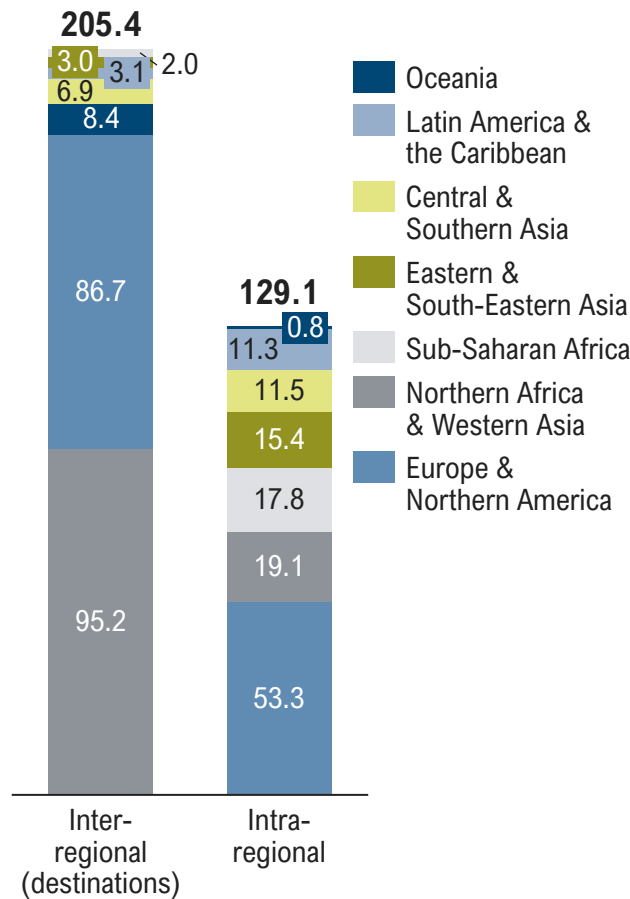


International net migration flows between regions are expected to be on a high level toward 2050 – This reflects only one of many aspects of migration

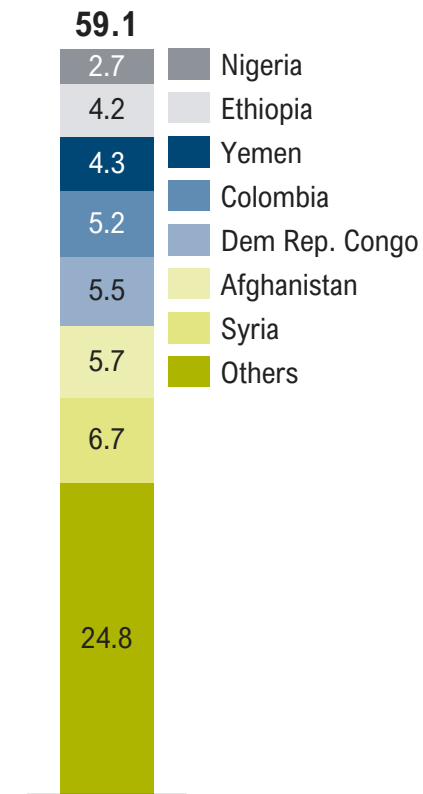
Cumulative net inter-regional migration flows 2023-2050¹⁾ [m]



Interregional and intraregional migrants (stock) 2020²⁾ [m]



Migrants within countries (IDPs³⁾ stock) 2021 [m]



- > According to the UN, **"international migrants** are defined as either **living** in a country **other than their country of birth** or in a country other than their **country of citizenship"**
- > The **majority of international migrants** (interregional and intraregional migrants) are **not refugees or asylum seekers** having left their home country due to conflicts, persecution or similar, but are defined as migrating for **economic, educational or other reasons**
- > In **2021** there have been **31.7 million international refugees and asylum seekers** globally; 69% came from just five countries: Syria, Venezuela, Afghanistan, South Sudan, and Myanmar
- > **IDPs** are **refugees** who stay **within their own country**. 2021, the **majority of IDPs** (53.2 million) **fled conflicts and violence**, the remaining 5.9 million fled disasters

1) Interregional migration includes only migration between regions; data are based on UN medium variant forecast
 2) Numbers of interregional migrants are for destination regions; intraregional migration includes only migration between countries within a region; 3) IDPs: internally displaced people
 Sources: UN Population Division; IOM; Internal Displacement Monitoring Centre/Norwegian Refugee Council; Roland Berger

1 People & Society



1.1
Population



1.2
Migration



1.3
Education & Labor



1.4
Values

2 Politics & Governance

3 Environment & Resources

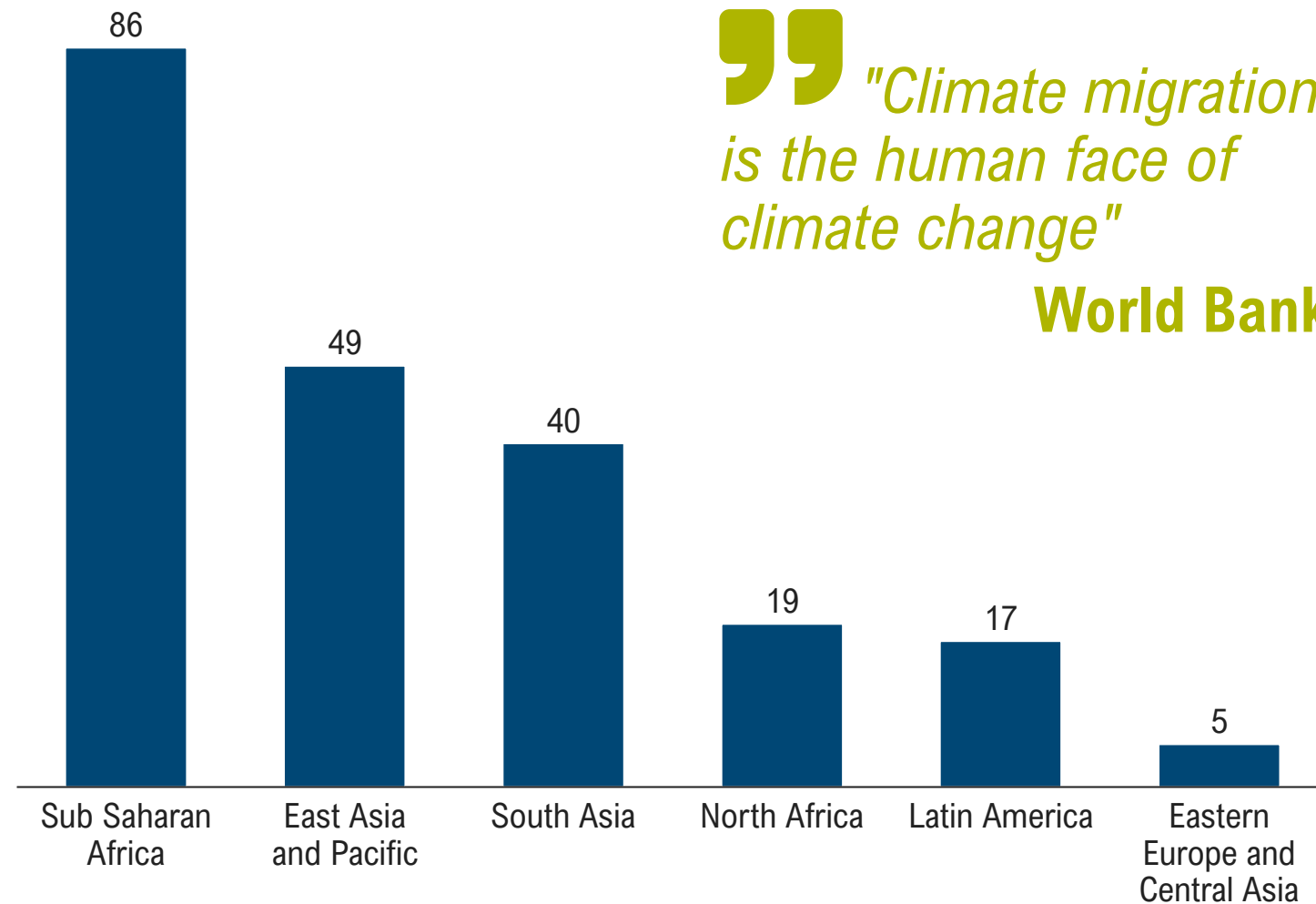
4 Economics & Business

5 Technology & Innovation

6 Health & Care

Without global action until 2050, up to 216 million internal climate migrants are forecast – Sub-Saharan Africa and Asia will be affected the most

Internal climate migrants in selected regions 2050 according to World Bank's pessimistic scenario [m]



“Climate migration is the human face of climate change”

World Bank

- > Global climate and environmental migration forecasts to 2050 range widely, from 25 million to 1 billion people
- > The majority of climate migrants will become internally displaced, i.e. they will be forced to move within their own country due to increasing climate change impacts such as rising sea levels, crop failure, water stress etc.
- > In a pessimistic scenario (high green-house gas emissions combined with unequal development pathways), the World Bank expects 216 million internal climate migrants across the six World Bank regions
- > According to World Bank estimates, the global community could manage to lower the number of people forced to move due to climate change by 60-80% if we manage to cut greenhouse gases, embed climate migration in development planning, and invest to improve our understanding of internal climate migration in the first place

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

2 Politics & Governance

3 Environment & Resources

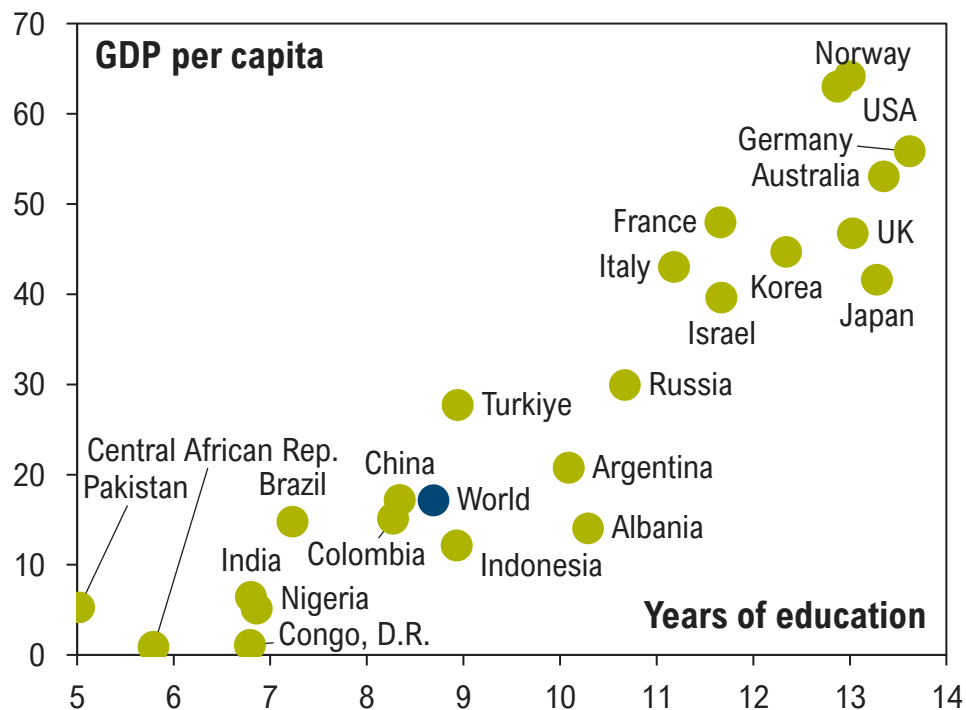
4 Economics & Business

5 Technology & Innovation

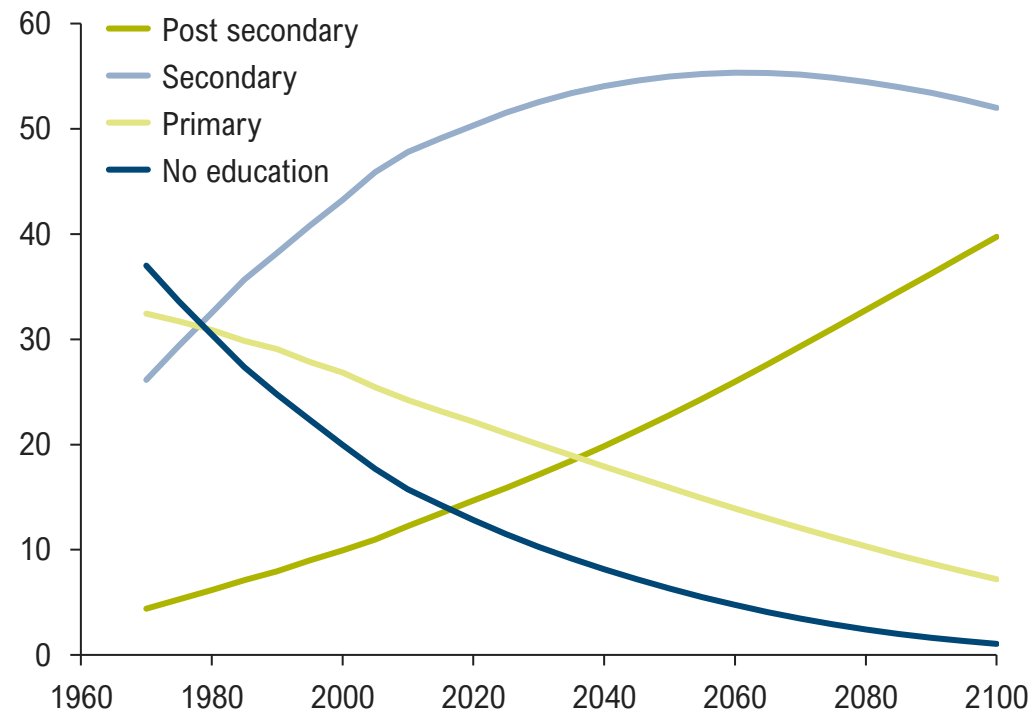
6 Health & Care

Education is key to individual and national prosperity – Globally, more and more people will have access to higher education

Average number of years of education completed in 2020 related to GDP per capita PPP in 2020¹⁾ [years, USD '000]



Highest educational attainment of global adult population [share in %]



- > Our world will be **inhabited by more and more educated people** as the share of people with no education continues to decrease
- > By 2050, **only five countries are predicted to have a share of non-educated people that is >20%**: Burkina Faso, Ethiopia, Guinea, Mali, and Niger
- > This rising level of educational attainment is a result of **changing attitudes** towards education, **more public investment**, and **new methods**, such as the opportunity to increasingly access education online

1) Number of years of education completed by people aged 25+. PPP stands for purchasing power parity. GDP per capita PPP in current (2020) international Dollar
Sources: Wittgenstein Centre; World Bank; Roland Berger

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

2 Politics & Governance

3 Environment & Resources

4 Economics & Business

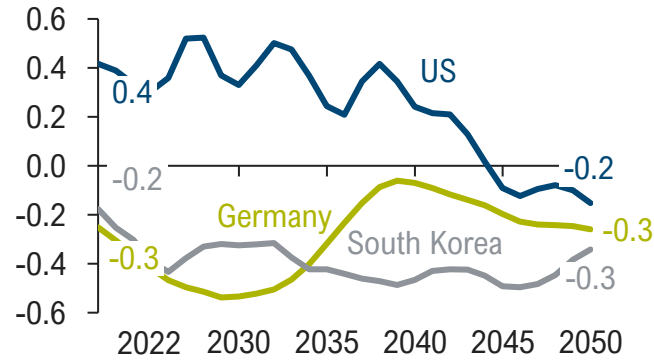
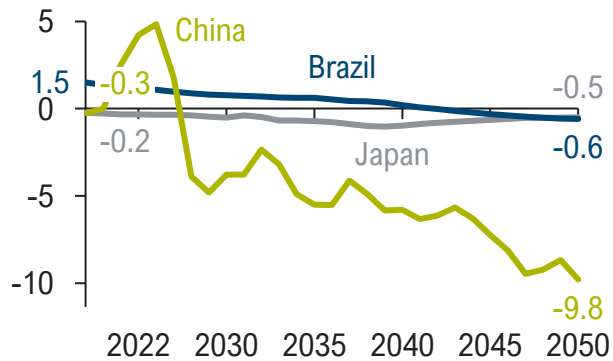
5 Technology & Innovation

6 Health & Care

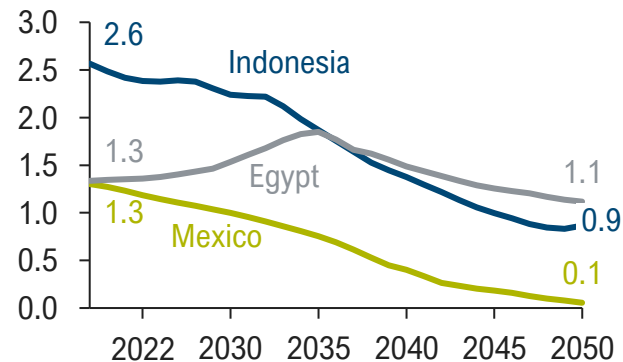
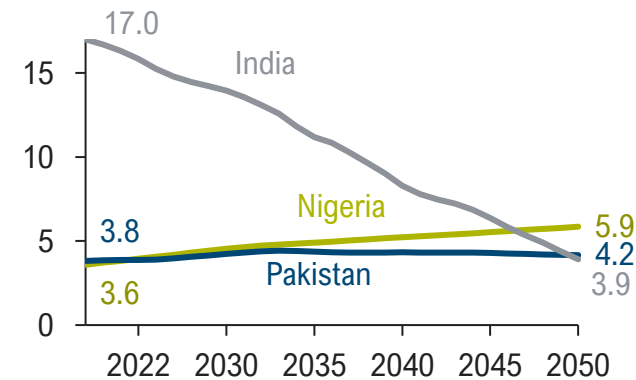
The shortage of skilled workers poses a problem for many labor markets – One possible option is to attract skilled workers from developing economies

Potential net-inflows p.a. into the workforce in the respective year 2022-2050¹⁾ [m]

Countries with a negative/mixed net-inflow 2022-2050



Countries with a positive net-inflow 2022-2050



- > In many advanced economies the youngest age groups of **the baby boomers** (born 1946-1964) – a very large age cohort – will exit **the workforce** in coming years
- > During this period, the new **cohort entering the workforce** is much **smaller**, thus resulting in a **negative net-inflow** in these countries
- > Because of the (now abolished) **one-child-policy**, **China**, the world's largest labor market, will also face a **shrinking workforce** from 2027
- > **Countries with high fertility rates** will have a **positive net-inflow**. **Attracting skilled workers from these countries** can be one option to counter the looming shortage of such workers in advanced economies – but there are pros and cons:
 - **Pros:** easing workforce shortages in advanced economies, attractive prospects for skilled workers from developing economies, further education and training of skilled workers in advanced economies (who can later apply these new skills if returning to their country of origin), remittances supporting the welfare and prosperity in developing economies
 - **Cons:** brain drain in developing economies, family separation, cost of attracting and integrating workers, language and cultural barriers
- > **Selected other measures to increase the workforce in advanced economies:** increase women's participation, educate non-skilled people to enable them to enter the workforce, increase the retirement age, increase working times

1) The potential net-inflow is the difference between potential inflow (people aged 20 entering work force within the current year) and potential outflow (people aged 65, leaving the workforce in the current year)

Sources: UN Population Division; Roland Berger

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

People and values: According to the signatories of the UN Declaration of Human Rights, everyone is entitled to the 30 rights and freedoms therein – In reality, claiming these entitlements is mixed and fraught with setbacks

Universal Declaration of Human Rights 1948: Article 2

"Everyone is entitled to all the **rights and freedoms** set forth in this Declaration, **without distinction of any kind, such as race, color, sex, language, religion, political or other opinion, national or social origin, property, birth or other status.** (...)"

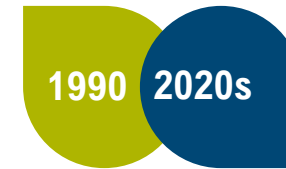
Selected rights and freedoms:

- > Article 1: "All human beings are born free and equal in dignity and rights. (...)"
- > Article 3: "Everyone has the right to life, liberty and security of person."
- > Article 5: "No one shall be subjected to torture or cruel, inhuman or degrading treatment or punishment."

Sources: UN; UNCRC; UNICEF; Reporters without borders; Roland Berger

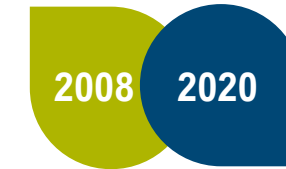
Human rights: Selection of significant developments

140 (now 196) countries ratify UN Convention on the Rights of the Child



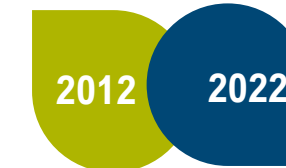
1 in 10 children are subjected to child labor worldwide – COVID-19 disrupted an otherwise encouraging downward trend

Barack Obama becomes the first African-American president of the United States



"I can't breathe": George Floyd is brutally killed by police, sparking violent protests and social unrest

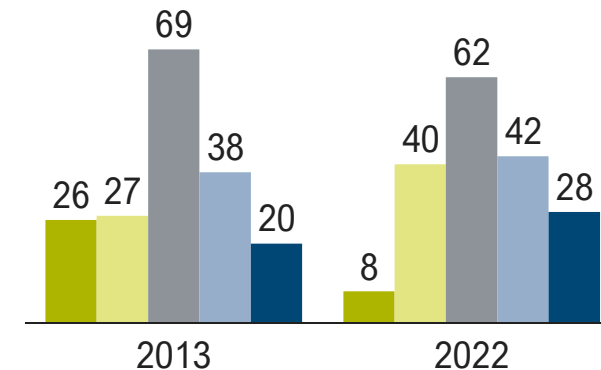
UN action plan on the safety of journalists



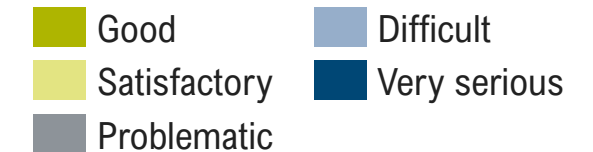
A record number (533) of journalists were imprisoned at the end of 2022, while 65 are held hostage and 49 are missing; 57 have been killed in 2022



Press freedom: Journalists are facing an increasingly difficult reporting environment



Number of countries, where the situation regarding the freedom of the press is ...



1 People & Society



1.1
Population



1.2
Migration



1.3
Education & Labor



1.4
Values

2 Politics & Governance

3 Environment & Resources

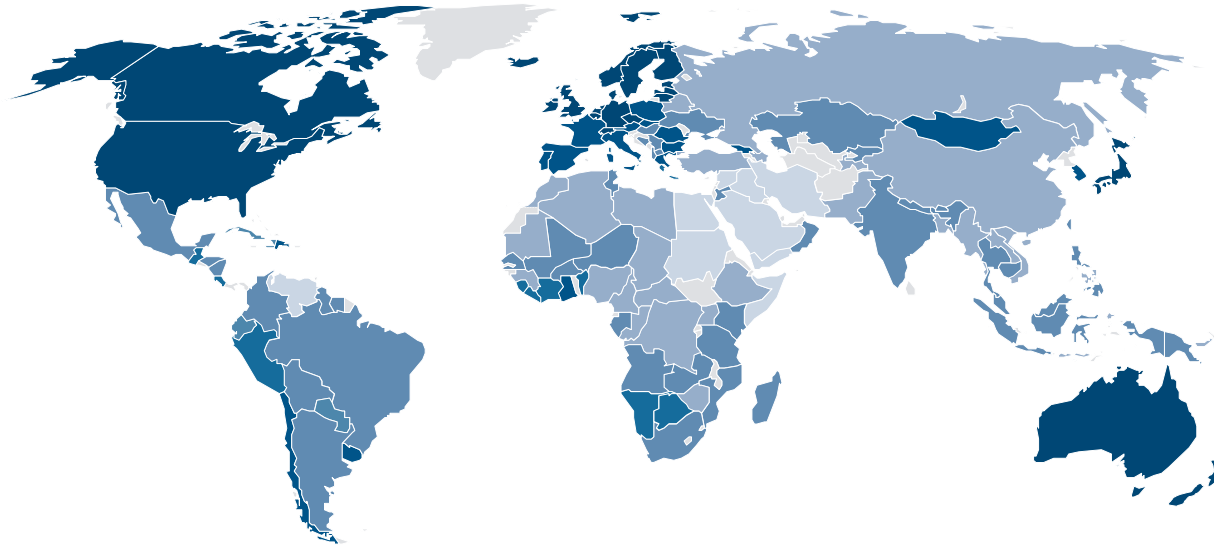
4 Economics & Business

5 Technology & Innovation

6 Health & Care

The evolution of human freedom paints a mixed picture – How will global values be shaped in the future?

Human Freedom Index 2022



Less freedom  More freedom  No data 

Less free – the trajectory of global human freedom: Since 2008, the Human Freedom Index (based on a composite of 50% personal and 50% economic indicators) has decreased, with a sharp decline during the COVID-19 pandemic, from 7.03 in 2019 to 6.81 in 2020 – the lowest level of freedom of the past two decades. The index is rather widespread between 0 and 10, Switzerland has the highest value (8.94), Syria the lowest (3.30). There are **110 countries with a decreasing level of freedom** and 31 countries with increased ratings. Personal freedom indicators, in particular, declined markedly

Sources: Cato Institute; Foresight Alliance; Roland Berger

What to look out for toward 2050

Through to 2050, the **global consensus on values** based on human rights and personal, civil and economic freedoms will **shift alongside the global power shift**. Changes in values and beliefs, in geopolitical power, socio-economic evolution, and technology denote what lies ahead

Selected push-and-pull factors include:

- > The tendency towards **rivalrous multipolarity** – what does it mean for **global values**?
- > If **rising powers approach protecting human rights** (also beyond their borders) and adjust their own self-determination policies – or not
- > Whether **common efforts to solve global problems** (climate change, biodiversity loss, UN Sustainable Development Goals, etc.) lead to a **common recognition of important human rights** – or not
- > Whether **emerging middle classes** push for more rights (even if not full democracy) as historically has been the case – or not
- > How **bottom-up technologies that enhance freedom evolve** vis-a-vis top-down surveillance and information control
- > If the **Internet remains an unfettered information conduit** – or not

1 People & Society



1.1 Population



1.2 Migration



1.3 Education & Labor



1.4 Values

2 Politics & Governance

3 Environment & Resources

4 Economics & Business

5 Technology & Innovation

6 Health & Care

Main sources

Megatrend 1 – People & Society

United Nations (UN) Population Division: World Population Prospects 2022. <https://population.un.org/wpp/Download/Standard/Population/>

UN Population Division: World Urbanization Prospects 2018. <https://population.un.org/wup/Download/>

UN Population Division: International Migration 2019. https://www.un.org/en/development/desa/population/migration/publications/migrationreport/docs/InternationalMigration2019_Report.pdf

UN International Organisation for Migration (IOM): World Migration Report 2022. <https://publications.iom.int/books/world-migration-report-2022>

Internal Displacement Monitoring Centre/Norwegian Refugee Council: Global Report on Internal Displacement 2022. <https://www.internal-displacement.org/global-report/grid2022/>

World Bank: Groundswell Report – Part 2, 2022. <https://openknowledge.worldbank.org/handle/10986/36248>

Wittgenstein Centre: Human Capital data, March 2023. <http://dataexplorer.wittgensteincentre.org/wcde-v2/>

World Bank: GDP data, March 2023. <https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD>

UN: Universal Declaration of Human Rights, 1948. <https://www.un.org/en/universal-declaration-human-rights/>

UN: Plan on Safety for Journalists, 2012. https://www.un.org/depts/german/menschenrechte/UN_Plan_on_Safety_Journalists_DUED.pdf

Reporters without borders: World Press Freedom Index 2022. <https://rsf.org/en/index>

Cato Institute: The Human Freedom Index 2022. <https://www.cato.org/sites/cato.org/files/2023-01/human-freedom-index-2022.pdf>

Foresight Alliance: Who Will Be Free? The Battles for Human Rights to 2050, 2012. http://www.foresightalliance.com/wp-content/uploads/2012/10/Future_of_human_rights.pdf

Megatrend 2

Politics & Governance



2 Politics & Governance

- 2.1 Global Risks
- 2.2 Geo-politics
- 2.3 Future of Democracy

Global risks center around environmental concerns while geopolitical power shifts are underway – Decline of democratic traits accelerates

Subtrends of megatrend "Politics & Governance"



Global Risks



Geo-politics



Future of Democracy

Anticipating global risks is central to proficient politics and good governance – For the decade ahead, environmental risks weigh in heavily

Top 20 global risks on a ten-year horizon by likely severity of impact

- 1 ■ Failure to mitigate **climate change**
- 2 ■ Failure of **climate-change adaptation**
- 3 ■ **Natural disasters** and **extreme weather** events
- 4 ■ **Biodiversity loss** and **ecosystem collapse**
- 5 ■ Large-scale **involuntary migration**
- 6 ■ **Natural resource crises**
- 7 ■ **Erosion of social cohesion** and **societal polarization**
- 8 ■ Widespread **cybercrime** and **cyber insecurity**
- 9 ■ **Geoeconomic confrontation**
- 10 ■ Large-scale **environmental damage incidents**
- 11 ■ **Misinformation** and **disinformation**
- 12 ■ Ineffectiveness of **multilateral institutions** and **international cooperation**
- 13 ■ **Interstate conflict**
- 14 ■ **Debt crisis**
- 15 ■ **Cost-of-living crisis**
- 16 ■ Breakdown of **critical information infrastructure**
- 17 ■ **Digital power** concentration
- 18 ■ Adverse outcomes of **frontier technologies**
- 19 ■ Failure to stabilize **price trajectories**
- 20 ■ **Chronic diseases** and **health conditions**

■ Economic ■ Environmental ■ Geopolitical ■ Societal ■ Technological

- > The World Economic Forum's Global Risks report is based on its annual **Global Risks Perception Survey**, completed by more than **1,200 members** from the WEF's network of business, government, civil society thought leaders, policy makers and risk experts. Input for the 2023 report was sought in the fall of 2022
- > The WEF defines **global risk** as "the possibility of the occurrence of an event or condition which, if it occurs, would **negatively impact** a significant proportion of global GDP, population or natural resources."
- > Among the WEF Global Risks 2023 assessment with a 10-year view, **environmental (climate- and nature-related) risks clearly dominate** the top 5 as well as the top 10 going forward – a trend evident for more than half a decade
- > **However, a wider variety of global risks is jostling for the attention of decision makers:** Beyond the top 10, the impact of **geopolitical** as well as **technological** risks are both more pronounced in the top 20 long term, while **societal** risks are spread throughout. Most notably among the latter, **challenges brought on by large-scale involuntary migration** takes fifth position

Nearer term and at country level, national economic and geopolitical challenges dominate – National risk perception is uneven

Five most important risks for 2023 and 2024 by selected countries¹⁾

	1	2	3	4	5
US	Debt crisis	Rapid and/or sustained inflation	Geoeconomic confrontation	Cost-of-living crisis	Failure of climate-change adaptation
China	Geoeconomic confrontation	Natural disasters & extreme weather events	Rapid and/or sustained inflation	Infectious diseases	Asset bubble burst, Digital power concentration, Geopolitical contestation of resources
Japan	Geoeconomic confrontation	Natural disasters & extreme weather events	Prolonged economic stagnation	Severe commodity price shocks	Geopolitical contestation of resources
Germany	Rapid and/or sustained inflation	Severe commodity price shocks	Interstate conflict	Severe commodity supply crises	Geopolitical contestation of resources
India	Digital inequality	Geopolitical contestation of resources	Cost-of-living crisis	Debt crisis	Natural disasters and extreme weather events
UK	Cost-of-living crises	Debt crises	Rapid and/or sustained inflation	Failure of climate-change adaptation	Terrestrial biodiversity loss & eco-system collapse, Interstate conflict, Asset bubble burst
France	Debt crisis	Severe commodity price shocks	Rapid and/or sustained inflation	Cost-of-living crisis	Erosion of social cohesion
Canada	Cost-of-living crisis	Debt crisis	Rapid and/or sustained inflation	Failure of climate-change adaptation	Asset bubble burst
Italy	Debt crises	Interstate conflict, Rapid and/or sustained inflation		Failure of climate-change adaptation	Asset bubble burst
Brazil	Rapid and/or sustained inflation	Proliferation of illicit economic activity	Geoeconomic confrontation	Severe economic price shocks, Employment and livelihood crises	
Australia	Cost-of-living crisis	Debt crises	Rapid and/or sustained inflation	Geoeconomic confrontation	Failure of climate-change adaptation
South Korea	Rapid and/or sustained inflation	Proliferation of illicit economic activity	Severe commodity supply crises	Asset bubble burst, Debt crisis	

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological

1) Top 12 countries by GDP in 2022 included in the study; 2) Survey undertaken April - September 2022, Russia not included

Sources: WEF; IMF; Roland Berger

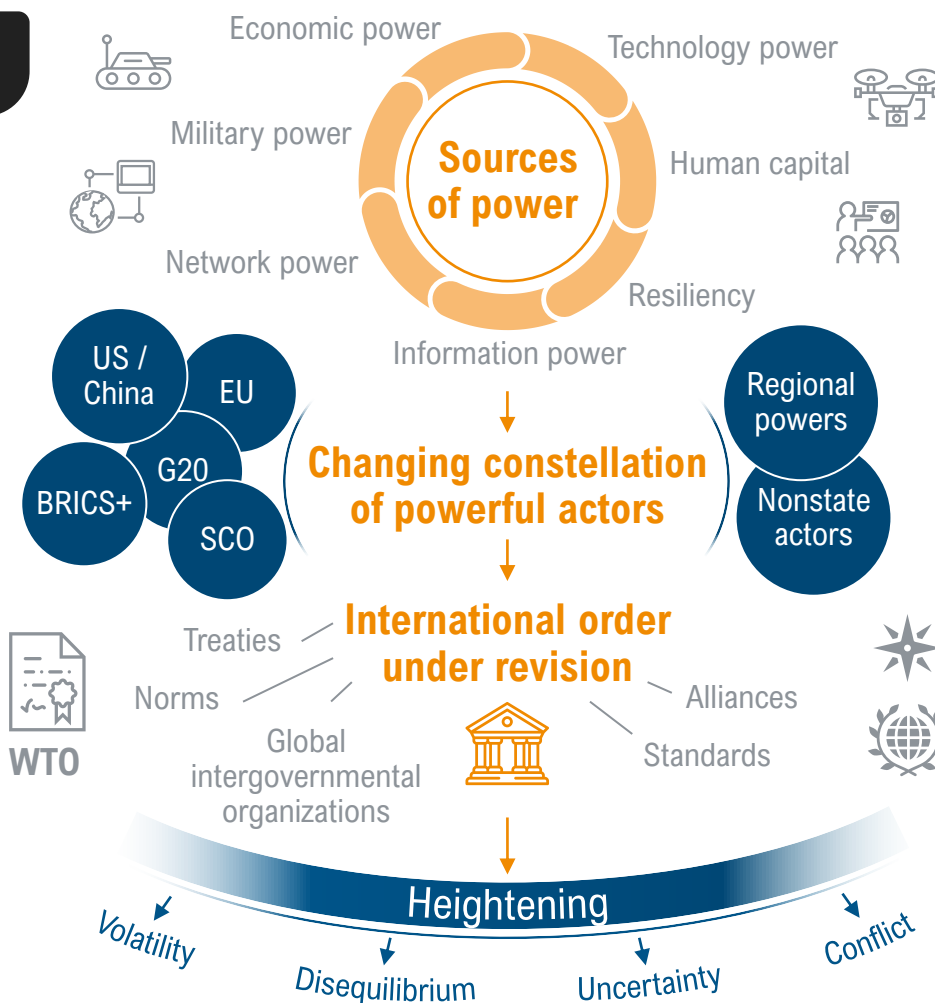
- > For the World Economic Forum's Executive Opinion Survey over 12,000 respondents from 121 economies were asked to assess the **most pressing issues for the next two years in their country²⁾**
- > Within this shorter time frame, **national perceptions of critical risks vary substantially**, highlighting top local concerns – or their absence when compared to other countries
- > For the next two years, **economic and geopolitical risks weigh heavily** among executives in the largest economies; beyond that, a more **mixed picture** can be observed
- > **Climate- and nature-related risks feature in very different ways:** China and the US, for example, are **the world's largest CO₂ emitters**; however, for 2023 and 2024 China is more concerned with risks stemming from natural disasters and weather events (#2) when compared to the US, where the risk of failure of climate-change adaptation is the #5 concern

The geopolitical fallout of global shocks is unearthing new tensions, embedding structural change among the constellation of powerful actors

Factors and challenges influencing the global world order

"Shocks of recent years – most notably, the **war in Ukraine** and **COVID-19 pandemic** – have reflected and accelerated an epochal **change to the global order**. Risks that are more severe in the short term are **embedding structural changes** to the **economic and geopolitical landscape** that will accelerate other global threats faced over the **next 10 years.**"

World Economic Forum



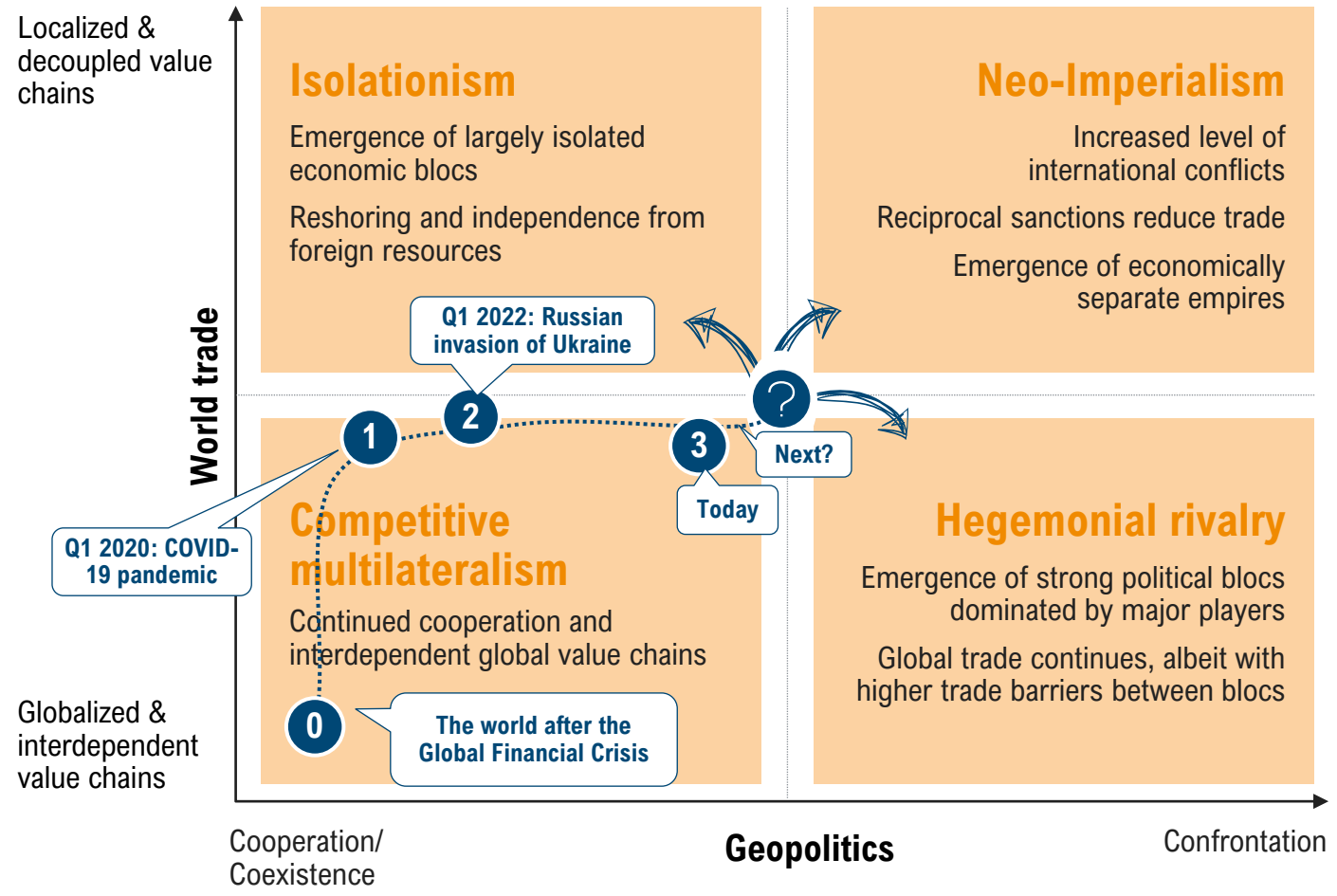
Reshuffling the global order of powerful players, blocs and international alliances

> Due to Russia's invasion of Ukraine, **NATO's importance is renewed**. At present the alliance has **31 member countries**, including **Finland** which joined NATO in **April 2023**. **Sweden's application** to join has been formally submitted, but ratifications by Hungary and Turkey are **still pending**; three countries (**Ukraine, Bosnia and Herzegovina, Georgia**) show strong aspirations to join

> New **hybrid unions** are becoming more prominent: in June 2023, India will be hosting the **Shanghai Cooperation Organization (SCO)**, a Eurasian organization for mutual **security, political and economic cooperation** founded in 2001. Full members include China, Russia, India, Iran, Pakistan, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Iran is set to become a full member, Saudi-Arabia is set to become a dialogue member. Turkey has expressed a wish to join this forum, causing friction with other NATO members

Along dimensions of geopolitics and world trade we see four different scenarios for a future world order

International order scenario matrix

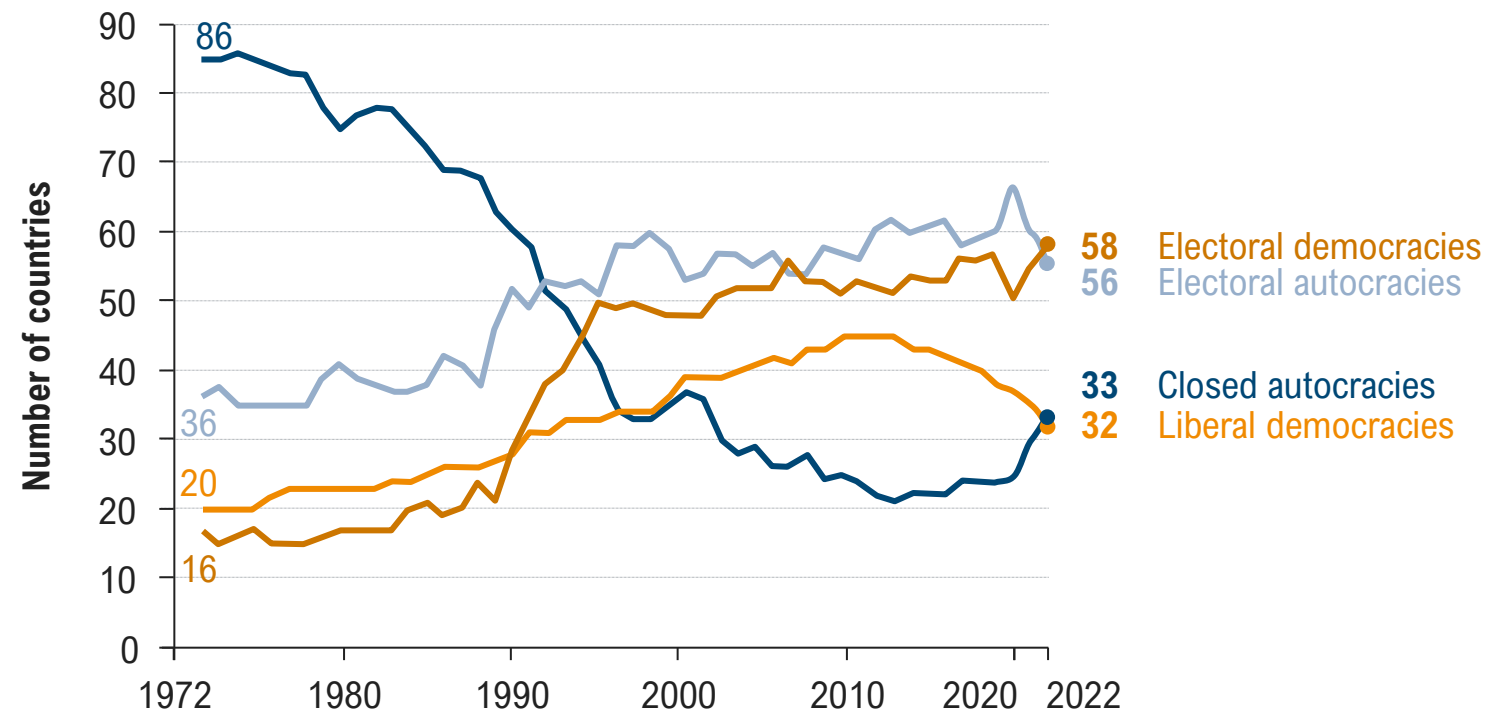


- > For some time, global governance displays a notable tendency toward **rivalrous multipolarity**, where major powers and blocs compete more intensely and less cooperatively on the global stage – leaving the rest of the world to strike a difficult balance
- > While the pace of globalization continues to slow, a **transition to more unilateral action of major powers can be observed**, as is evident in the **rise of trade protectionism** – the latest example being the US IRA¹⁾
- > Established **global value chains** rely on a liberal, cooperative and peaceful world order. The Russian invasion of Ukraine has shown that such a world cannot be taken as a given and subsequent sanctioning of the Russian invasion has further **polarized the international order** while the war exacerbates already existing economic disruptions and challenges such as inflation and shortages stemming from the global pandemic
- > At the same time, this has raised the question of what the **relationship of democratic states with authoritarian/autocratic regimes** may look like in the future

1) Inflation Reduction Act of 2022
Sources: Roland Berger; US Congress

A more divided world: Autocratization trends are intensifying – The future of liberal democracy is under threat

Number of countries classified by regime type, 1972-2022¹⁾



- > **Electoral democracies** are the **most common regime type**; electoral democracies as well as electoral autocracies have increased in numbers over the past five decades – the latter, for example, includes Serbia, Hungary, and India
- > The most recent years' **increase** in the number of **electoral democracies** may appear to be a positive but is largely a **consequence of liberal democracies undergoing** (gradual) **autocratization**
- > For the first time since 1995, there are **fewer liberal democracies than closed autocracies**; the former decline from a **peak of 44 in 2009 to 32 in 2022**
- > The number of **closed autocracies** has gone up from a low of 22 in 2012 to 33 in 2022, highlighting the other momentum of the current wave of autocratization. In recent years, countries such as **Afghanistan, Chad, Guinea, Haiti, Iran, Mali, Myanmar, Turkmenistan, and Uzbekistan** have fallen under this regime type

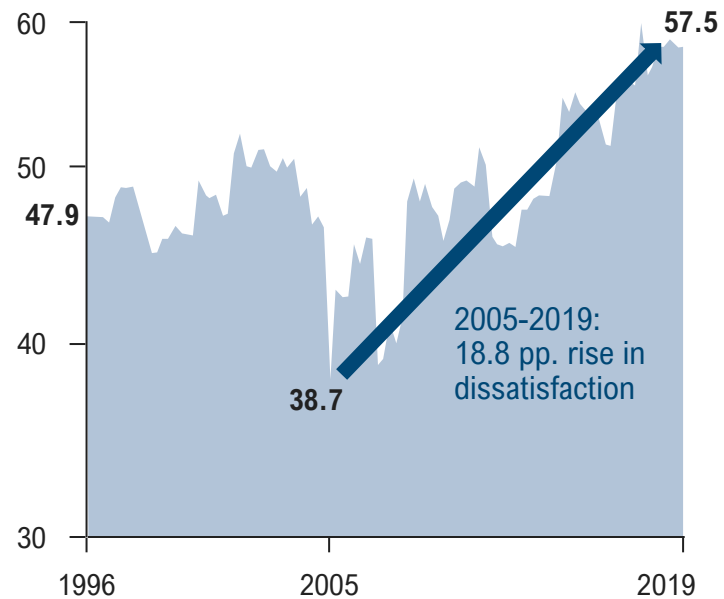
The University of Gothenburg varieties of democracies (V-DEM) dataset covers 470+ indicators for 200+ countries. According to V-DEM, **electoral democracies** are systems where a number of institutional features guarantee free and fair elections such as freedom of association and freedom of expression; **liberal democracies** in addition include protection of individual liberties, and the checks and balances between institutions; **autocracies (electoral or closed)** display a sliding lack of such features

1) Uncertainty remains about regimes that exhibit similar degrees of authoritarian and democratic traits and thus are close to the threshold between democracy and autocracy. In 2022, such uncertainty applied to 16 countries. Thus, the **number of autocracies** in the world might range from 84 to 100 countries, with **89 being the best estimate**
 Sources: University of Gothenburg/V-Dem Institute; Roland Berger

Within democracies, public dissatisfaction with democracy is on the rise since 2005 – However, amongst advanced economies views vary widely

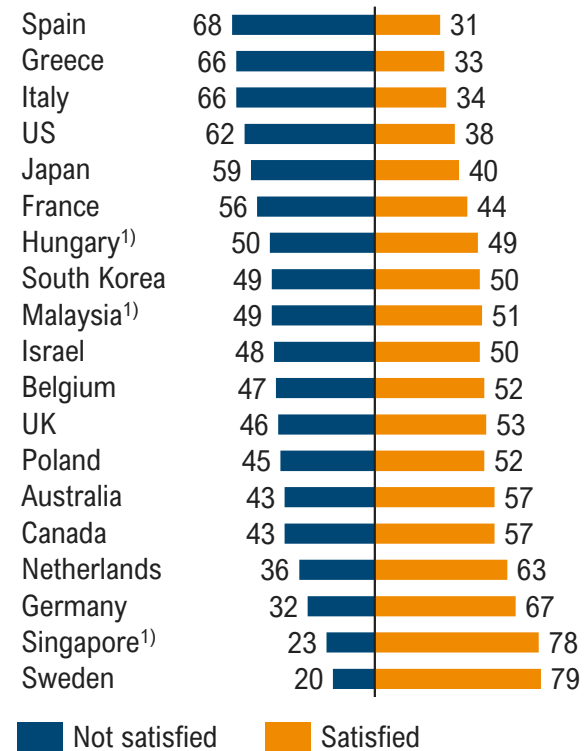
Global dissatisfaction with democracy, 1996-2020 and spring 2022 [%]

Share of population in 77 democracies being dissatisfied with democracy, 1996-2020 [%]



The University of Cambridge's Centre for the Future of Democracy tracks the 'mood' in **77 democracies**; observations are based on a constant-country, population-weighted sample of these democracies for which data exists from the mid-1990s to 2019. This represents 2.4 billion individuals across all continents

Share of population in selected democracies being not satisfied/satisfied with democracy, spring 2022 [%]



Pew Research surveyed public attitudes in 19 advanced economies from March to May 2022

- > Across the globe, democracy appears to be in a **state of discontent**: **dissatisfaction with democracy has risen over time**
- > 2019 represents the **highest level of democratic discontent** on record: nearly 58% are unhappy with democracy
- > The **rise in democratic dissatisfaction** has been especially sharp **since 2005**, with just 38.7% of citizens dissatisfied in that year. Since then, the proportion of dissatisfied citizens in the 77 observed democracies has risen by almost one-fifth of the population
- > But **views can vary widely at the national level**: according to a Pew Research survey undertaken across **19 advanced economies** in spring 2022 **levels of dissatisfaction** with democracy are notable in southern European nations (Spain, Italy, Greece) but also the US, while northern European countries (Sweden, Germany, Netherlands, Poland, UK) appear more satisfied with the way democracy is working in their country

1) Hungary, Malaysia and Singapore are electoral autocracies according to the V-DEM University of Gothenburg classification

Sources: University of Cambridge Bennett Institute; Pew Research Center; Roland Berger

Democratic leaders stand united: Combatting autocratic trends is high on their agenda – Russian invasion of democratic Ukraine adds significance

Latest US and EU democratic efforts and themes and the standpoint of Ukraine

USA: International Democracy Summit



Held in 2021 & 2023

Three key themes:

- Defending against authoritarianism
- Addressing and fighting corruption
- Advancing respect for human rights

“*Democracy doesn’t happen by accident. We have to defend it, fight for it, strengthen it, renew it.*”

Joe Biden
President of the US

EU: European Democracy Action Plan



Launched December 2020

Includes measure on:

- Electoral integrity
- Tackling disinformation
- Media freedom
- Media pluralism

“*Democracy is Europe’s most powerful diplomatic tool. Our work to uphold democracy globally has never been so important.*”

Ursula von der Leyen
President, EU Commission



“*Together we need to save Ukraine. Together we need to save the world of democracy.*”

Volodymyr Zelensky, President of Ukraine

- > The **future of democracy** requires **concerted efforts** – not just in times of war
- > A notable, **renewed level of recognition** of the importance and value of democracy has reached political leaders in democracies
- > Standing united can contribute to their **strength, but only if citizens are equally committed** to democratic principles
- > This **succeeds only if institutions and processes are truly democratic** (fairness, no corruption, checks and balances) and if they are efficient and contribute to prosperity – and if democratically elected leaders abide by this mandate



2.1
Global Risks



2.2
Geo-politics



2.3
Future of Democracy

Main sources

Megatrend 2 – Politics & Governance

World Economic Forum (WEF): Global Risks Report 2023. https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf

National Intelligence Council (NIC): Global Trends 2040 – A more contested world, March 2021. <https://www.dni.gov/index.php/gt2040-home>

United Nations (UN): UN votes to suspend Russia from the Human Rights Council, 7 April 2022. <https://news.un.org/en/story/2022/04/1115782>

North Atlantic Treaty Organization (NATO): Enlargement and Article 10. https://www.nato.int/cps/en/natohq/topics_49212.htm

UK Government/Ministry of Defence: Global Strategic Trends 2050 – The future starts today (6th edition, 2018). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/771309/Global_Strategic_Trends_-_The_Future_Starts_Today.pdf

European Commission: EU-China - A Strategic Outlook, March 2019. <https://commission.europa.eu/system/files/2019-03/communication-eu-china-a-strategic-outlook.pdf>

University of Gothenburg/Varieties of Democracy (V-Dem): Varieties of Democracy report 2023. https://www.v-dem.net/documents/29/V-dem_democracyreport2023_lowres.pdf

University of Cambridge Bennett Institute/Centre for the Future of Democracy (Foa, R.S., Klassen, A., Slade, M., Rand, A. and R. Collins): The Global Satisfaction with Democracy Report 2020. https://www.cam.ac.uk/system/files/report2020_003.pdf

Pew Research Center: Global Attitudes Survey, Spring 2022. <https://www.pewresearch.org/global/2022/12/06/satisfaction-with-democracy-and-political-efficacy-in-advanced-economies-2022/>

US State Department: International Democracy Summit(s) 2021 & 2023. <https://www.state.gov/summit-for-democracy/>

European Commission: European Democracy Action Plan. https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/european-democracy-action-plan_en



Megatrend 3

Environment &
Resources



Accelerating mitigation of global climate change effects is a must – In the future, biodiversity, water, food, and raw materials face critical issues

Subtrends of megatrend "Environment & Resources"

 **3.1**
Climate Change & Pollution

 **3.2**
Bio-diversity

 **3.3**
Resources & Raw Materials

1



Climate Change
& Pollution

2



Bio-
diversity

3



Resources &
Raw Materials

3.1 Climate Change & Pollution

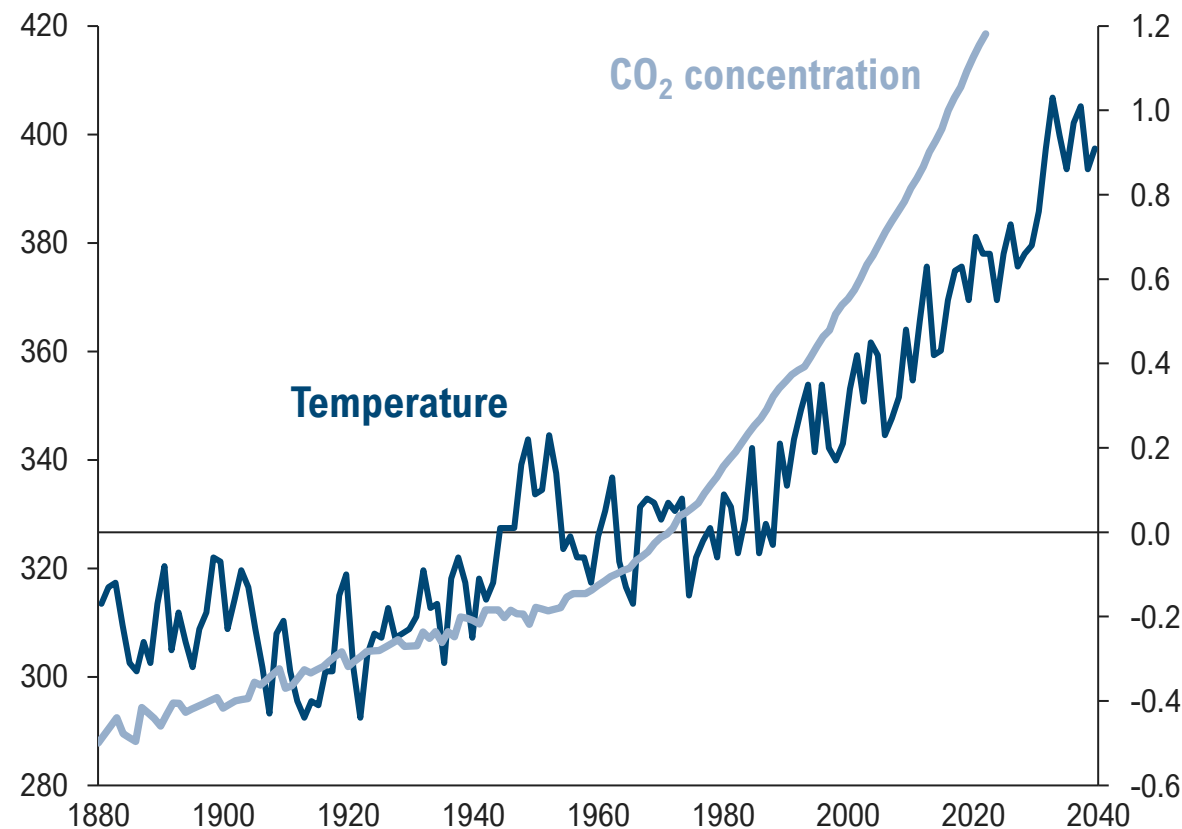
3.2 Bio-diversity

3.3 Resources & Raw Materials

Alongside CO₂ concentration increases, the global average temperature has risen over the last century – Both trends continue in this century

CO₂/Temperature increase nexus

CO₂ concentration in the atmosphere [left scale, ppm] and global temperature anomalies compared to the average global temperature in the 20th century [right scale, °C]



- > Carbon dioxide (CO₂) concentration in the atmosphere in-creased significantly since 1880 and even more rapidly within the past 60 years. Today it is well above 400 parts per million (ppm). This is the highest level for at least 800,000 years
- > In parallel to the rise in CO₂ concentration, the global average temperature increased around 1.2°C above pre-industrial levels
- > The graph only shows CO₂ concentration. Other greenhouse gases (GHG) also contribute to the greenhouse effect and human-induced climate change: besides CO₂, methane (CH₄) and nitrous oxide (N₂O) also play an important role
- > CO₂'s lifetime cannot be represented with a single value as some of the excess CO₂ is absorbed quickly (e.g. by the ocean surface) while some will remain in the atmosphere for thousands of years; methane lasts about 12 years and nitrous oxide around 109 years
- > To make GHG emissions comparable, scientists evaluate the Global Warming Potential (GWP), measuring the contribution to global warming of a specific mass of a GHG relative to the same mass of CO₂. Thus, using GWP, the CO₂-equivalent (CO₂e) of any GHG can be measured
- > Over 100 years, the GWP of methane and nitrous oxide are nearly 30 and 273 times higher, respectively, than the GWP of CO₂

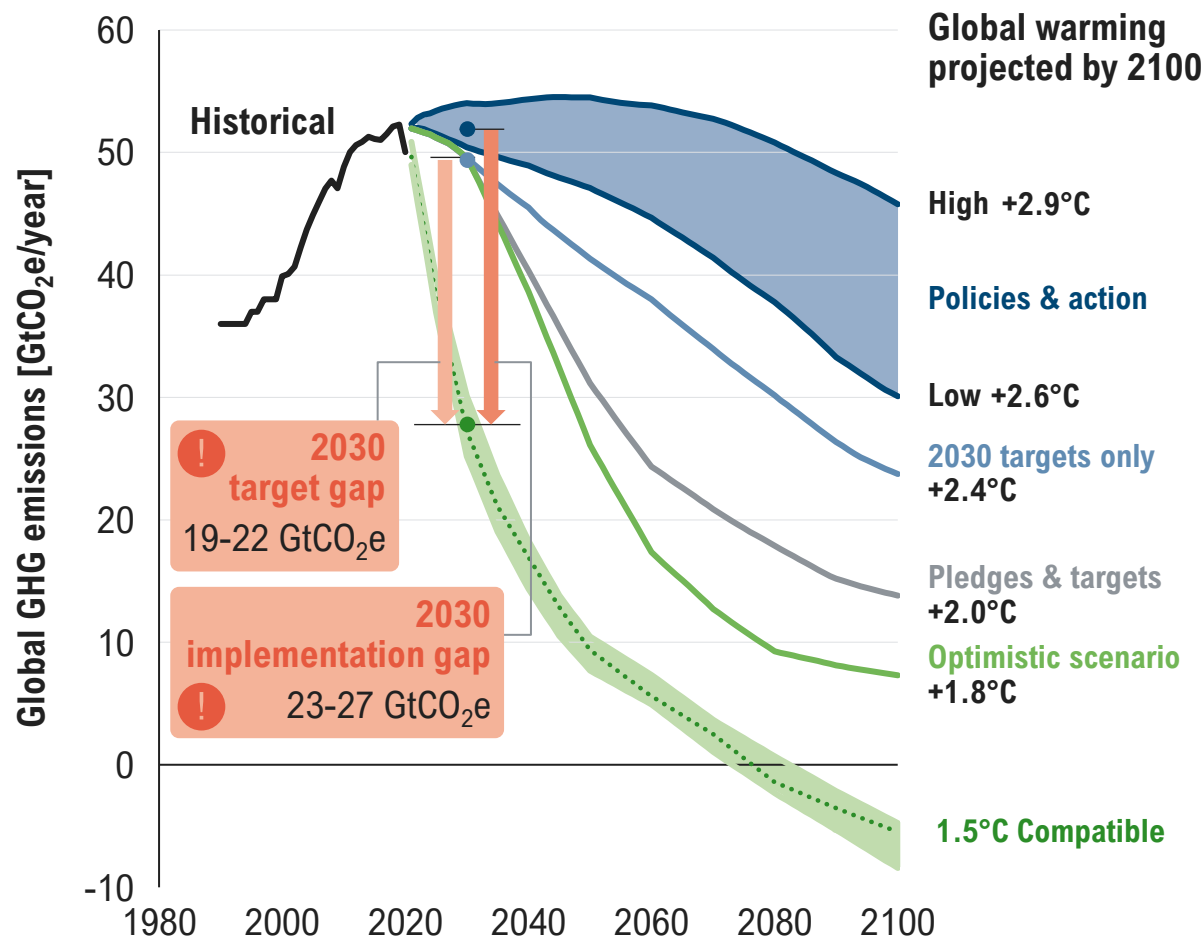
3.1 Climate Change & Pollution

3.2 Bio-diversity

3.3 Resources & Raw Materials

Human-induced global temperature increases can only be limited to 1.5°C if major additional efforts are made to reach carbon neutrality by 2080

2100 global warming projections under different scenarios



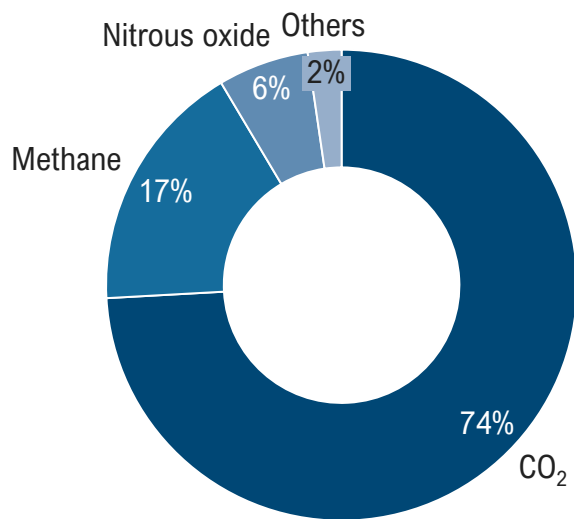
- > The **Climate Action Tracker (CAT)** visualizes various scenarios to show the effects of **different efforts to limit global warming**¹⁾
 - The scenario **"Policies & action"** refers to **laws which are currently in place** and will most likely result in a global warming of **2.6-2.9°C**
 - **"2030 targets only"** scenario refers to (intended) **nationally determined contributions of governments** within the **Paris Agreement**. This would lead to a global warming of **2.4°C**
 - If **binding long-term or net-zero targets** are included (**"Pledges & targets" scenario**) global warming could be limited to **2°C**
 - The **"optimistic scenario"** analyzes the effect of **net-zero emissions targets** that are either adopted or under discussion in around 140 countries. Here, the median warming estimate is **1.8°C**. As a warming above 2°C cannot be ruled out, this scenario is not Paris Agreement compatible
 - The **dotted green line** is the only case that is **1.5°C compatible**: in this scenario, **GHG emissions** need to be reduced rapidly to be brought to **zero between 2070 and 2080**
 - The **consequences of global warming** are **evident**: rising sea level, ice-free summers in the Arctic, melting glaciers, coral bleaching, heat waves, floods, storms, lower crop yields, extinction of species. The **intensity and irreversibility** of these impacts depend on the **level of the temperature rise**

1) The CAT is an independent scientific project that tracks government climate action and measures it against the globally agreed Paris Agreement aim of "holding warming well below 2°C, and pursuing efforts to limit warming to 1.5°C"

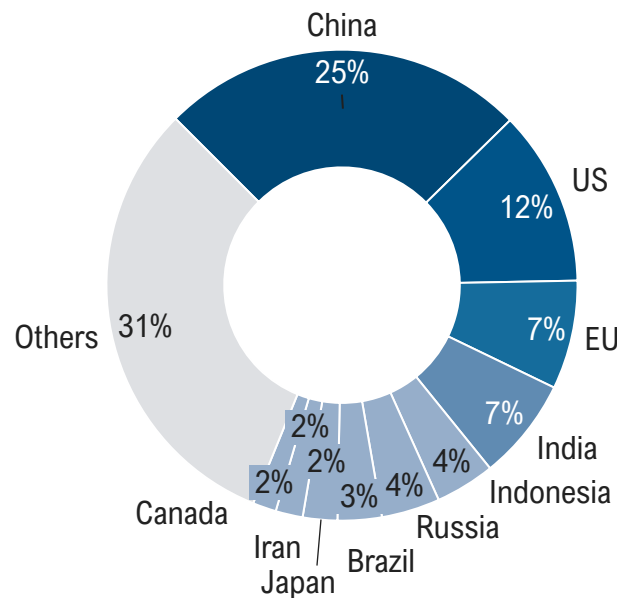
Sources: Climate Action Tracker; Roland Berger

CO₂ dominates the emissions mix while >2/3 of global GHG stem from just 10 emitters – Sectoral source analysis also points to actionable levers

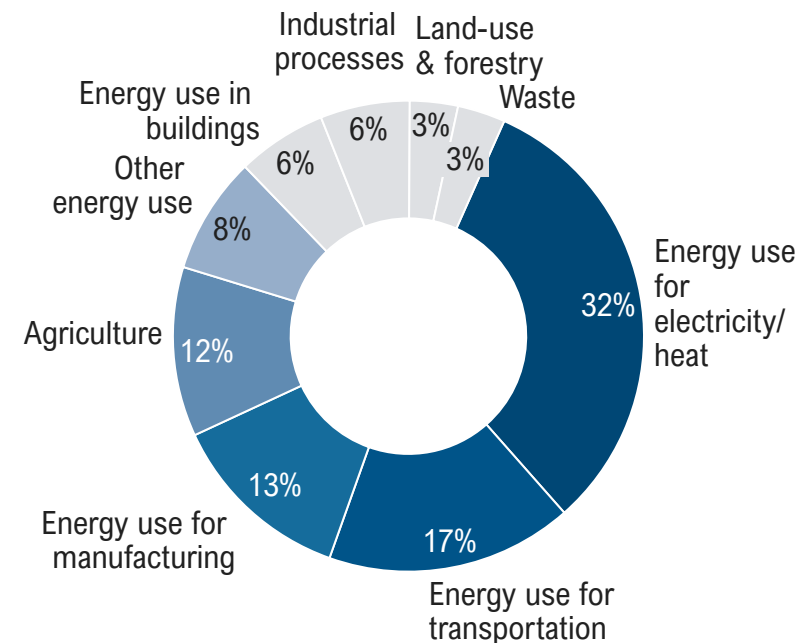
Composition of global GHG emissions 2019¹⁾



Biggest GHG emitters 2019



Sources of global GHG emissions 2019



Global GHG emissions 2019: **49.8 GtCO₂e**

Selected levers for GHG reductions: higher efficiency in industrial processes, increased use of renewable energy sources, regional production, better energy efficiency of buildings, smart solutions (e.g. in supply chains, mobility and logistics, cities)

1) GHG: green house gas; most recent data available
 Sources: World Resources Institute; Climate Watch; IEA; Global Change Data Lab; Roland Berger



3.1 Climate Change & Pollution








3.2 Bio-diversity



3.3 Resources & Raw Materials

Beyond GHGs: Other types of pollution are damaging our environment and threaten human health – Informed limitation and directed efforts are key

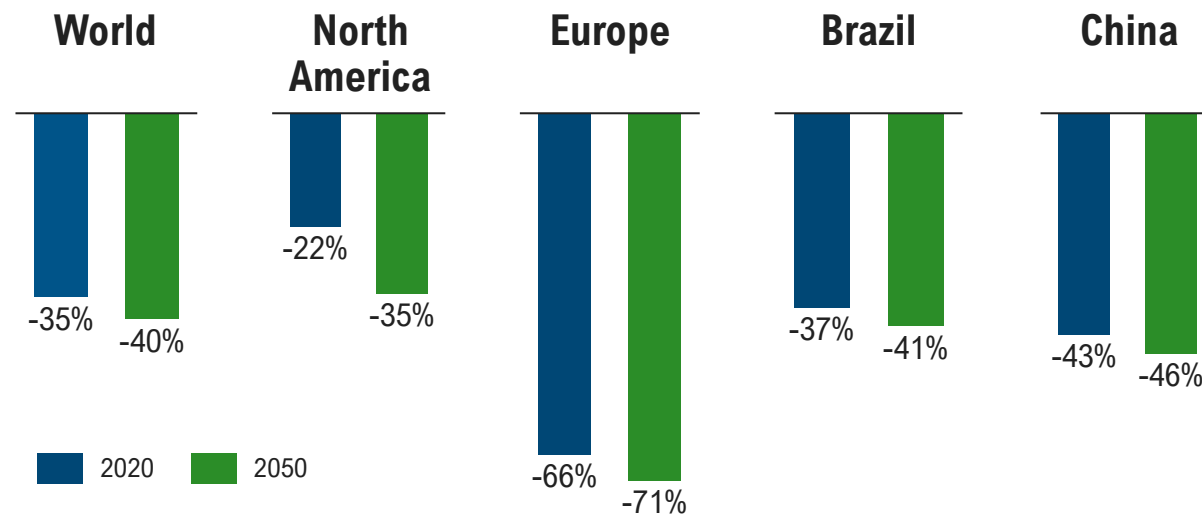
	Air pollution 	Water pollution 	Land pollution 	Noise pollution 	Light pollution 
Selected origins	Fuel combustion for energy production/transportation, heating, non-exhaust vehicle emissions, natural/chemical/nuclear catastrophes	Industry and household sewage, mines, vehicles & vessels, agricultural runoff, spillages, fracking, natural oil seeps, natural/chemical/nuclear catastrophes	Industry and household waste, mines, agriculture, natural/chemical/nuclear catastrophes	Vehicles, aviation, industrial/construction/mining activities, leisure pursuits	Public and private infrastructure, vehicles, industrial and leisure activities
Examples	Fine dust, sulfur dioxide, carbon monoxide, nitrogen oxides, ozone, chemical vapors, pollen, radioactive air pollutants	Waste (esp. plastics) and sewage, bacteria, oil, chemicals, pesticides and herbicides, fertilizer, tire abrasions, metals, drugs	Liquid, solid or sludge waste (open dump or landfill), microplastics in sewage sludge used as fertilizer, pesticides, herbicides, heavy metals	Traffic noise, flight paths, heavy machinery, music and video streaming, concerts	Over-illumination of streets/places/buildings/ industrial plants and facilities
	9 out of 10 people breathe air that exceeds WHO air pollution guidelines – Air pollution is responsible for 1 in 8 deaths worldwide	The Great Pacific Ocean Garbage Patch contains 1.8 trillion pieces of plastic in an area of 1.6 million km ² – 3x the size of France	Globally, 33% of waste is still openly dumped and approx. 40% goes to landfills	In middle- and high-income countries, 1 of 2 young people (aged 12-35 years) listen to unsafe levels of sound	83% of the world's population live under light-polluted skies

Pollution reduction and mitigation approaches

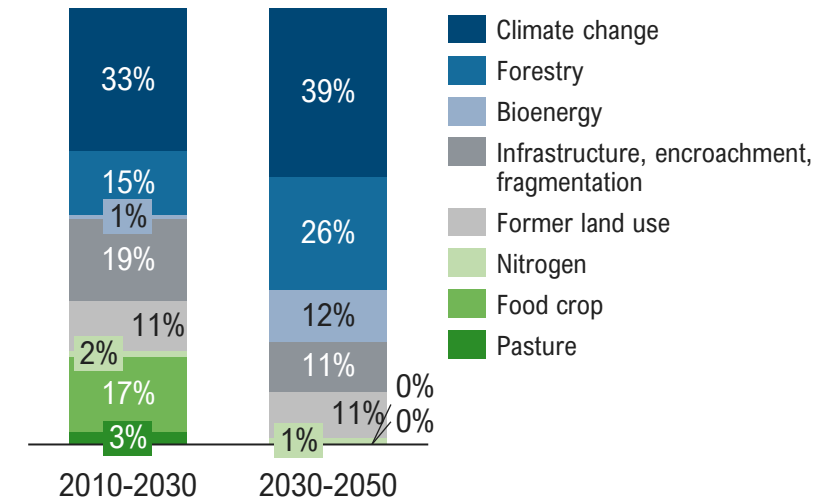
- > Ban (more) harmful pollutants
- > Set tighter pollution limits across all types of pollution
- > Implement emission-free/lower emission energy production and industrial processes
- > Switch to circularity approaches and longer-lasting, more sustainable products
- > Inform and improve better land use, waste and light management practices

Biodiversity is declining: One third of terrestrial species have been lost to date – The need to tackle rising pressures spurs new global treaties

Terrestrial mean species abundance loss 2020 and 2050 for selected regions and countries¹⁾ [% loss compared to pristine ecosystem]



Relative share of pressures to additional terrestrial biodiversity loss 2010-2030 and 2030-2050¹⁾ [%]



- > In December 2022, the **15th Conference of Parties (COP15)** to the **UN Convention on Biological Diversity (CBD)** adopted the **"Kunming-Montreal Global Biodiversity Framework" (GBF)**. Overall, this includes four goals and 23 targets for achievement by 2030 in terms of **biodiversity protection, restoration and funding**, comprising the so-called **'30 by 30 plan'** which aims to **protect and conserve 30% of the planet's land and sea by 2030** including indigenous and traditional lands. **Restoration** is to be **completed or underway** on **at least 30% of degraded** terrestrial, inland waters, and coastal and marine **ecosystems**
- > In addition, in March 2023, the Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ) secured the so-called **Treaty of the High Seas** (adopted by the UN in June 2023, ratification phase starting in September 2023). The treaty is a new **legally binding international instrument** to ensure the **conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction** through effective implementation of the relevant provisions of the UN Convention²⁾ and further international cooperation and coordination; this agreement reinforces efforts to protect biodiversity in line with the aims of the 2030 Agenda for Sustainable Development and the Kunming-Montreal Global Framework for Biodiversity

1) According to the Baseline scenario of the OECD, which includes steady GDP growth and a strong ongoing use of fossil fuels; 2) United Nations Convention on the Law of the Sea 1982
Sources: OECD; COP15; UN/BBNJ; Roland Berger

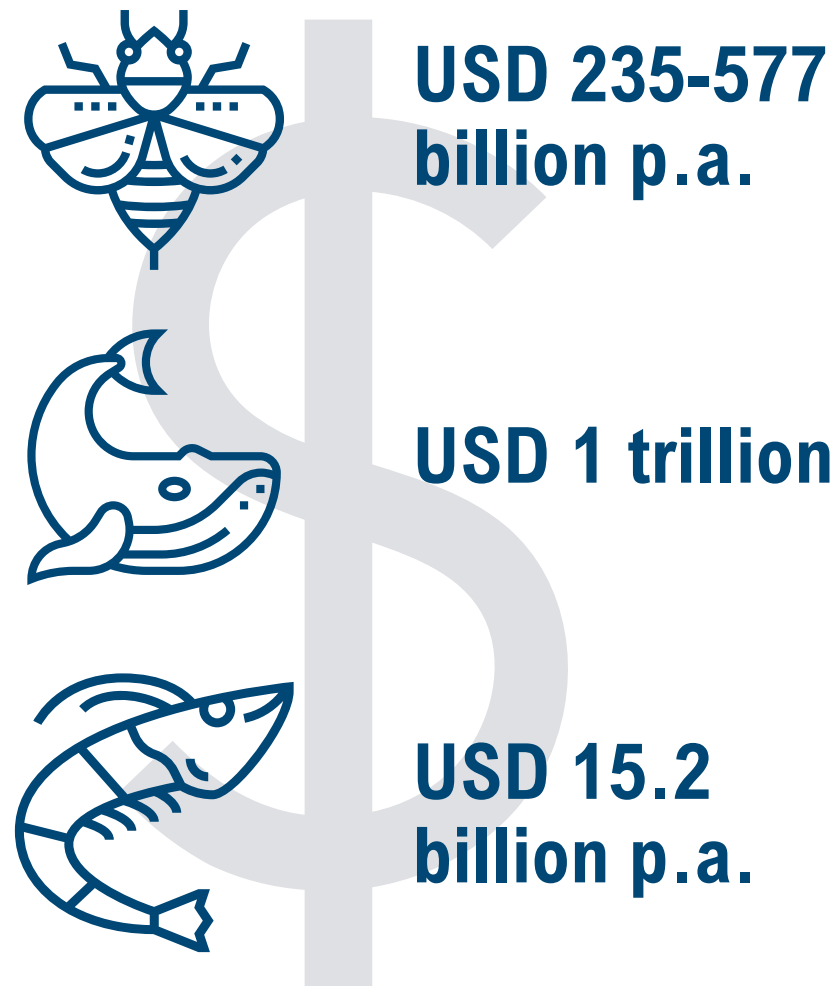
Sustainable biodiversity is a 'must have' for our planet and for our economy – More than half of global GDP is dependent on nature ...

Value of biodiversity for a sustainable and economically sound planet

- > Methods to quantify the economic value of biodiversity are complex yet important as biodiversity is under extreme pressure worldwide, with **one million animal and plant species threatened with extinction** according to UN estimates
- > WEF research shows that **USD 44 trillion of economic value generation** – more than half of the world's total GDP – is **moderately or highly dependent on nature** and its services, and therefore directly exposed to risks from nature loss

Three **illustrative examples**:

- > More than 75% of global food crops are dependent on insect pollinators, thus contributing 35% of global food production. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) the **annual value** of global crop output **at risk** due to **pollinator loss** is estimated at **USD 235-577 billion**
- > **Great whales** sequester 33 tons of CO₂ on average over their lifetime. Together with other economic effects such as fishery enhancement, ecotourism, and phytoplankton productivity (**capturing 37 billion tons CO₂ p.a.**), the IMF estimates the average value of a great whale at more than USD 2 million and the **value for the current stock of great whales at over USD 1 trillion**
- > **Antarctic krill** in the Antarctic Peninsula and Scotia Sea region deliver **carbon sequestration services** with an estimated (lower bound) value of **USD 15.2 billion annually**

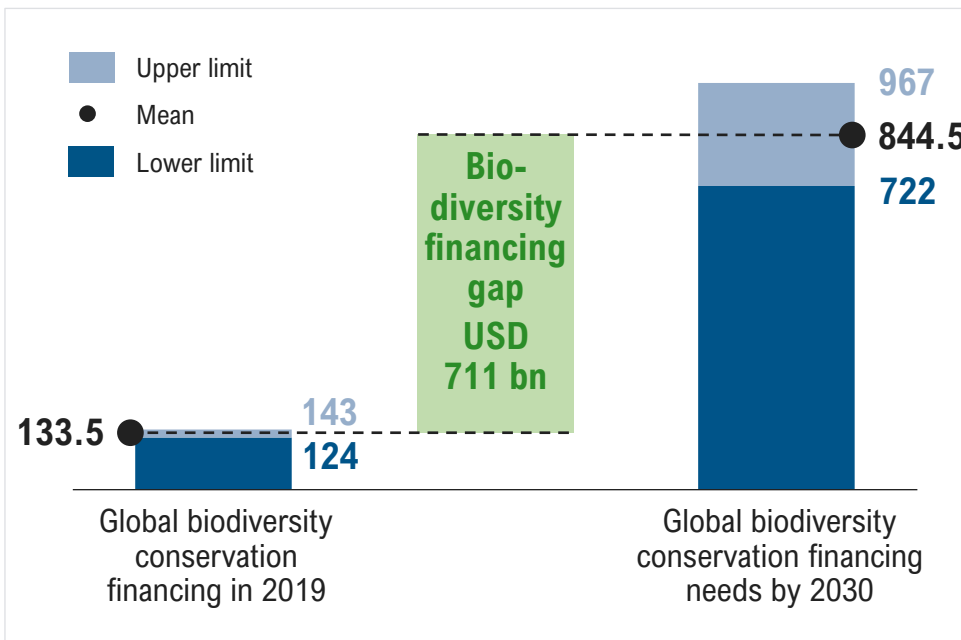


... but less than 1% of annual global GDP could close the USD 711 billion per year biodiversity funding gap conserving the planet's environment

Global biodiversity conservation financing vs. global biodiversity conservation needs [USD bn]

Current biodiversity financing flows

- > In 2019, the total **global** annual flow of funds toward **biodiversity protection** amounted to approx. **USD 124-143 billion p.a.**
- > Meanwhile, annual **government expenditure on activities harmful to biodiversity** in the form of agricultural, forestry, and fisheries subsidies – USD 274-542 billion p.a. in 2019 – is **two to four times higher than annual capital flows toward biodiversity conservation**



Future biodiversity spending needs

- > To **halt the decline** in global biodiversity requires **USD 722-967 billion p.a.** in spending between now and 2030
- > This leaves an estimated global **biodiversity financing gap of USD 598-824 billion p.a.** (average: **USD 711 billion**) – roughly equal to **just under 1% of annual global GDP**

The **Kunming-Montreal Global Biodiversity Framework (GBF)**, agreed at the 15th meeting of the Conference of Parties (COP15) to the UN Convention on Biological Diversity (CBD) in December 2022, addresses **key biodiversity funding issues at the global level** by targeting two areas

- > **The reduction of harmful subsidies:** progressively **phase out or reform by 2030 subsidies** that harm biodiversity by **at least USD 500 billion p.a.**, while scaling up positive incentives for biodiversity's conservation and sustainable use (*Target 18*)
- > **The mobilization of resources and effectiveness of funding flows:** by 2030, at least USD 200 billion p.a. in domestic and international biodiversity-related funding from all sources (public and private); to **raise international financial flows from developed to developing countries to at least USD 20 billion p.a. by 2025**, and to at least USD 30 billion p.a. by 2030 (*Target 19*)

3 Environment & Resources

3.1 Climate Change & Pollution

3.2 Bio-diversity

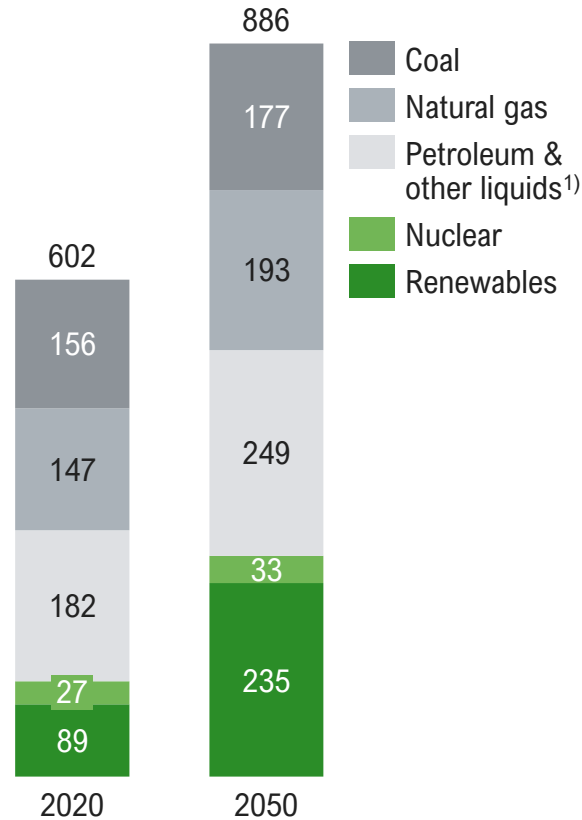
3.3 Resources & Raw Materials

An inconvenient truth about energy consumption: Unless concerted efforts modify global patterns, fossil fuels are still set to top the 2050 energy mix

Global energy consumption according to the EIA International Energy Outlook (IEO) 2021

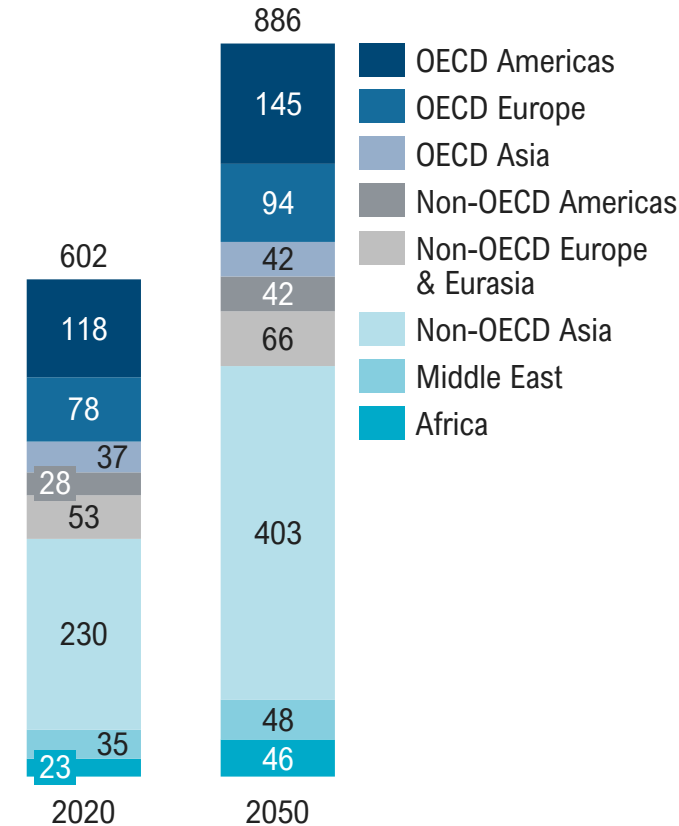
By fuel

World [quadrillion Btu]



By region

World [quadrillion Btu]



The IEO report is based on the following assumptions²⁾:

- > **2021 views** of economic and demographic **trends and improvements** in known technology
- > **Implementation of 2021 laws and regulations**

To lower consumption of fossil fuels, we need ...

- ... more and better **coordinated global efforts** to secure climate protection of a country or region (e.g. CO₂ pricing) while ensuring its global competitiveness
- ... more **energy efficiency** measures geared at halting the increase of overall global consumption
- ... more **technological innovations and solutions**, and an **open discussion** regarding potential consequences (e.g. new grids, hydrogen pipelines)
- ... to **pay the price for climate and biodiversity protection**, i.e. an understanding and acceptance of a loss of prosperity

1) Includes biofuels; 2) IEO 2021 reference case using EIA World Energy Projections System (WEPS)
Sources: EIA; Roland Berger

3 Environment & Resources

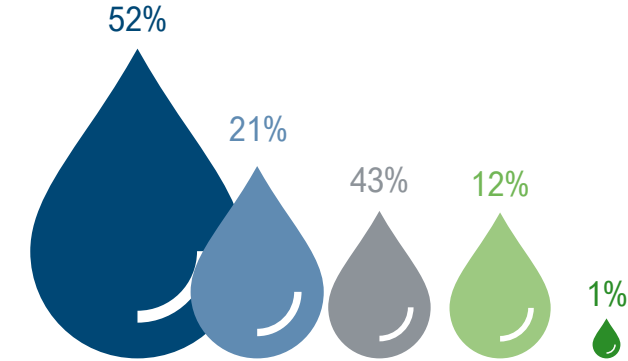
3.1 Climate Change & Pollution

3.2 Bio-diversity

3.3 Resources & Raw Materials

The demand for water is expected to grow significantly toward 2050 – Efficient water use/management is one of many levers to mitigate this rise

Global water demand 2020¹⁾ vs. 2050 [km³]



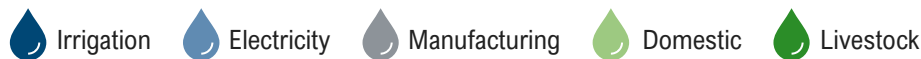
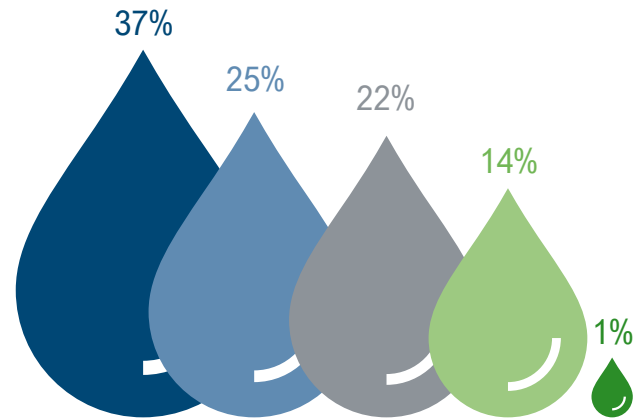
2020
4,325 km³



2050
5,467 km³

Water Main drivers of demand

- > Population growth
- > GDP growth
- > Growing prosperity
- > Urbanization
- > Sectoral change



Water

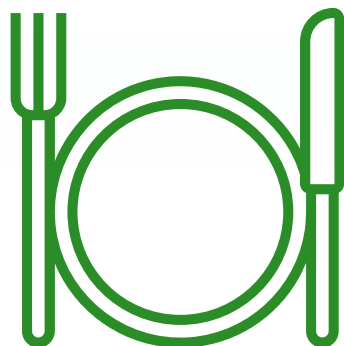
Main levers for a sustainable water resource management

- > Incentivize **water use** efficiency
- > Invest in **water storage** innovatively
- > Reconsider **water allocation** mechanisms
- > Mitigate water related **disasters**
- > Improve **wastewater** treatment/reduce run-off
- > Accelerate **water supply and sanitation** in developing countries
- > Improve **water governance** for coherence

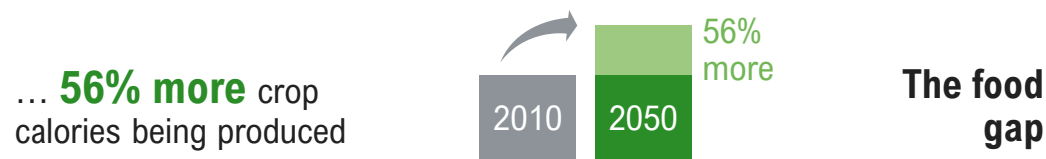
1) Linear extrapolation of 2000 and 2050 data
Sources: OECD; Roland Berger

Similarly, the demand for food is expected to rise substantially to 2050 – Multiple levers can help address the future food gap

Global food demand 2010¹⁾ vs. 2050 [km³]



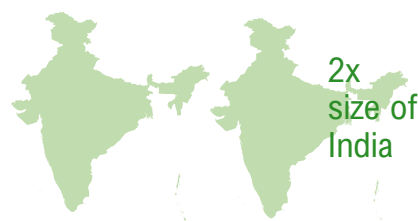
Three gaps that must be closed to achieve a sustainable food future in 2050: To meet the higher demand for food in 2050 we need (compared to 2010) ...



Food Main drivers of demand

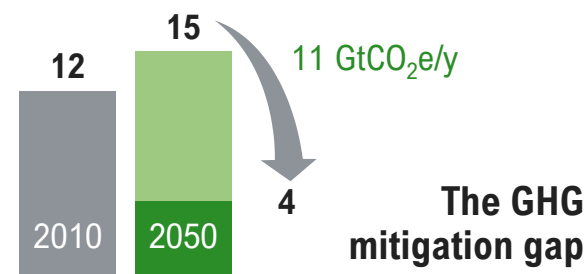
- > Population growth
- > Growing prosperity leading to a shift in diets

... **593 million ha** more agricultural land – twice the size of India



The land gap

... **11 GtCO₂e GHG** emissions p.a. in 2050 from agriculture and land-use change¹⁾ need to be lowered to 4 GtCO₂e p.a. to meet the 2°C Paris goal



Food

Main levers to close the gaps

- > Raise **productivity**
- > Manage **demand**
- > Link agricultural intensification to natural **ecosystems protection**
- > Moderate ruminant **meat consumption**
- > Target **reforestation** and peatland **restoration**
- > Require production-related **climate mitigation**
- > Spur technological **innovation**

1) Under current rate of productivity gains, emissions from agriculture and land-use change will increase to 15 GtCO₂e per year in 2050

Sources: World Resources Institute; Roland Berger

3.1

Climate Change & Pollution

3.2

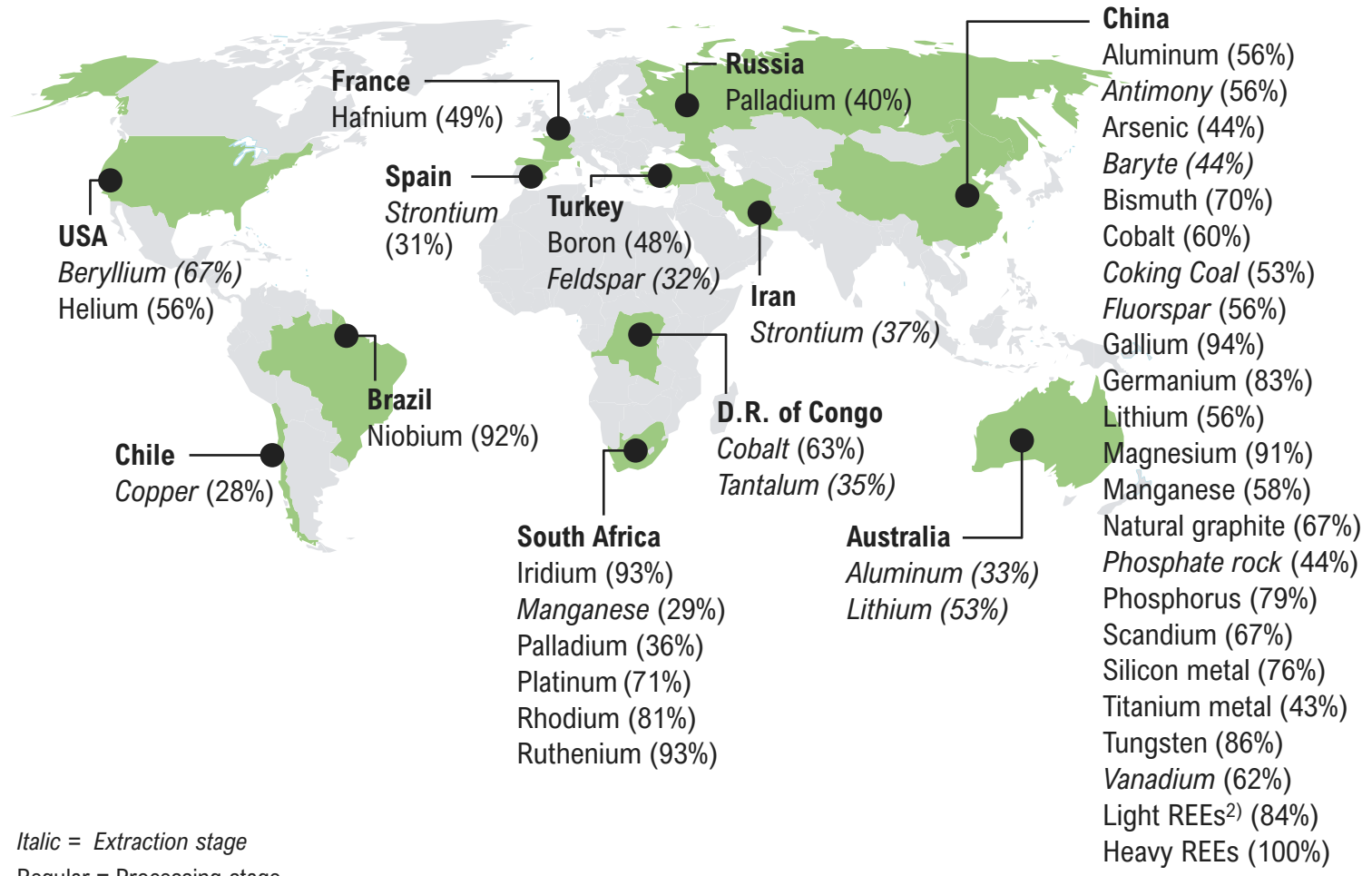
Bio-diversity

3.3

Resources & Raw Materials

Beyond water, food, and energy resources, many raw materials are critical for our economy – China is the dominant supplier of a wide range of CRMs

Countries accounting for largest share of global supply of selected critical raw materials (CRMs), 2023¹⁾ [%]



Italic = Extraction stage
 Regular = Processing stage

EU analysis concerning critical raw materials (CRM) and global suppliers

- > Since 2011 the EU reports on the global supply of raw materials. The 2023 (fifth) assessment covers 87 individual raw materials of global/EU importance
- > The EU defines a raw material as **critical** when its **economic importance** and its **supply risk** is **high**. For the EU, **34 raw materials** or raw material groups are identified as **critical**

Selected CRMs and examples of end-use

- > **Beryllium:** electronic and telecommunications equipment
- > **Germanium:** infrared optics
- > **Hafnium:** superalloys
- > **Rhodium:** auto catalysts
- > **Phosphate rock:** mineral fertilizer
- > **Tantalum:** capacitors
- > **Tungsten:** tools

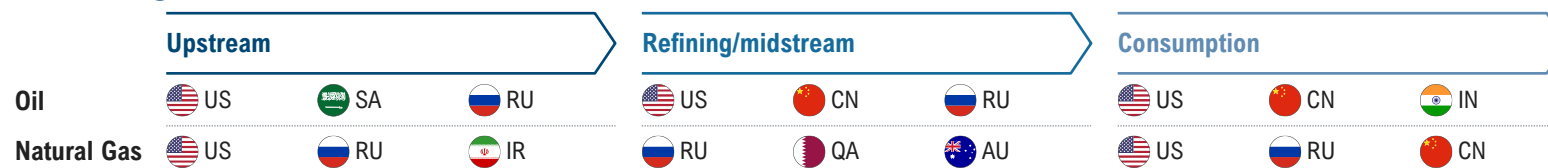
1) Main global producers/processors of raw materials listed as critical for the EU in 2023; 2) REEs: Rare Earths Elements
 Sources: European Commission; Roland Berger



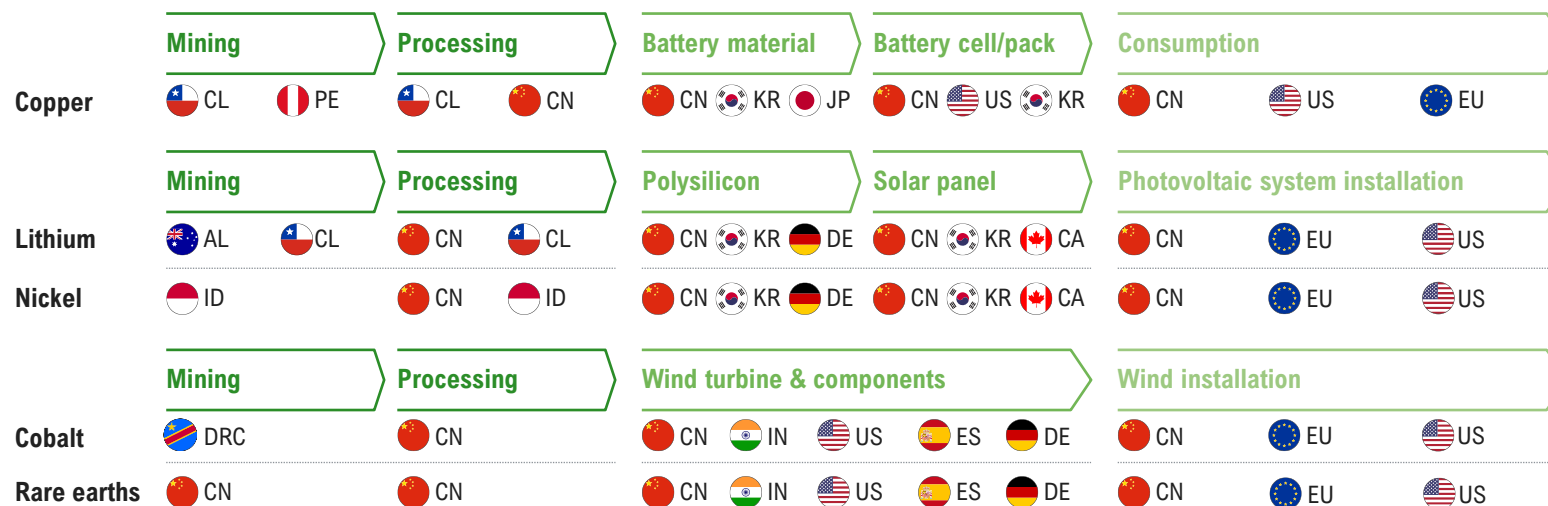
The transition to cleaner energy technologies and systems alters raw material dependencies – Future CRM demand is a multiple of today's

Indicative supply chain of fossil fuels and relevance of key clean energy raw material producing countries and countries of consumption (selective)

Oil and gas



Clean technologies



Looking ahead

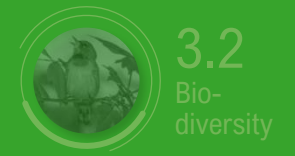
Regarding the global energy transition and its underlying clean-energy technologies, **certain CRMs will be much more in demand in the future:**

Mineral	Use in clean-energy tech	Rise in demand, 2050 relative to 2021, factor ²⁾
Cobalt	Electric vehicles (EVs), battery storage	6.2
Copper	Solar, wind, bio-energy, electricity networks, EVs, battery storage	2.8
Lithium	EVs, battery storage	24.0
Nickel	Geothermal, EVs, battery storage, hydrogen	12.3
REEs	Wind, EVs, battery storage	7.2

1) Largest producers and consumers are indicative only; 2) Data calculated under the IEA's Announced Pledges Scenario
Sources: IEA; WEF; MSC; Roland Berger

Main sources

Megatrend 3 – Environment & Resources



Climate Action Tracker: Temperatures. <https://climateactiontracker.org/global/temperatures/>

European Commission: Study on the Critical Raw Materials for the EU 2023 Final Report, March 2023. <https://single-market-economy.ec.europa.eu/system/files/2023-03/Study%202023%20CRM%20Assessment.pdf>

European Commission: Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study (2023). <https://single-market-economy.ec.europa.eu/system/files/2023-03/Raw%20Materials%20Foresight%20Study%202023.pdf>

COP15: Kunming-Montreal Global Biodiversity Framework, December 2022. https://prod.drupal.www.infra.cbd.int/sites/default/files/2022-12/221219-CBD-PressRelease-COP15-Final_0.pdf

Organisation for Economic Co-operation and Development (OECD): Environmental Outlook 2050, 2012. https://read.oecd-ilibrary.org/environment/oecd-environmental-outlook-to-2050_9789264122246-en#page1

International Energy Agency (IEA): The role of critical minerals in clean energy transition, May 2021. <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>

Intergovernmental Panel on Climate Change (IPCC): Sixth Assessment Report, Climate Change 2021 The Physical Science Basis. <https://www.ipcc.ch/report/ar6/wg1/>

World Resources Institute (WRI): Creating a sustainable food future, July 2019. https://research.wri.org/sites/default/files/2019-07/WRR_Food_Full_Report_0.pdf

Paulson Institute: Financing Nature, September 2020. https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf

WEF: Nature Risk Rising, January 2020. http://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf

WEF: Global Risks Report. https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf

Megatrend 4

Economics
& Business



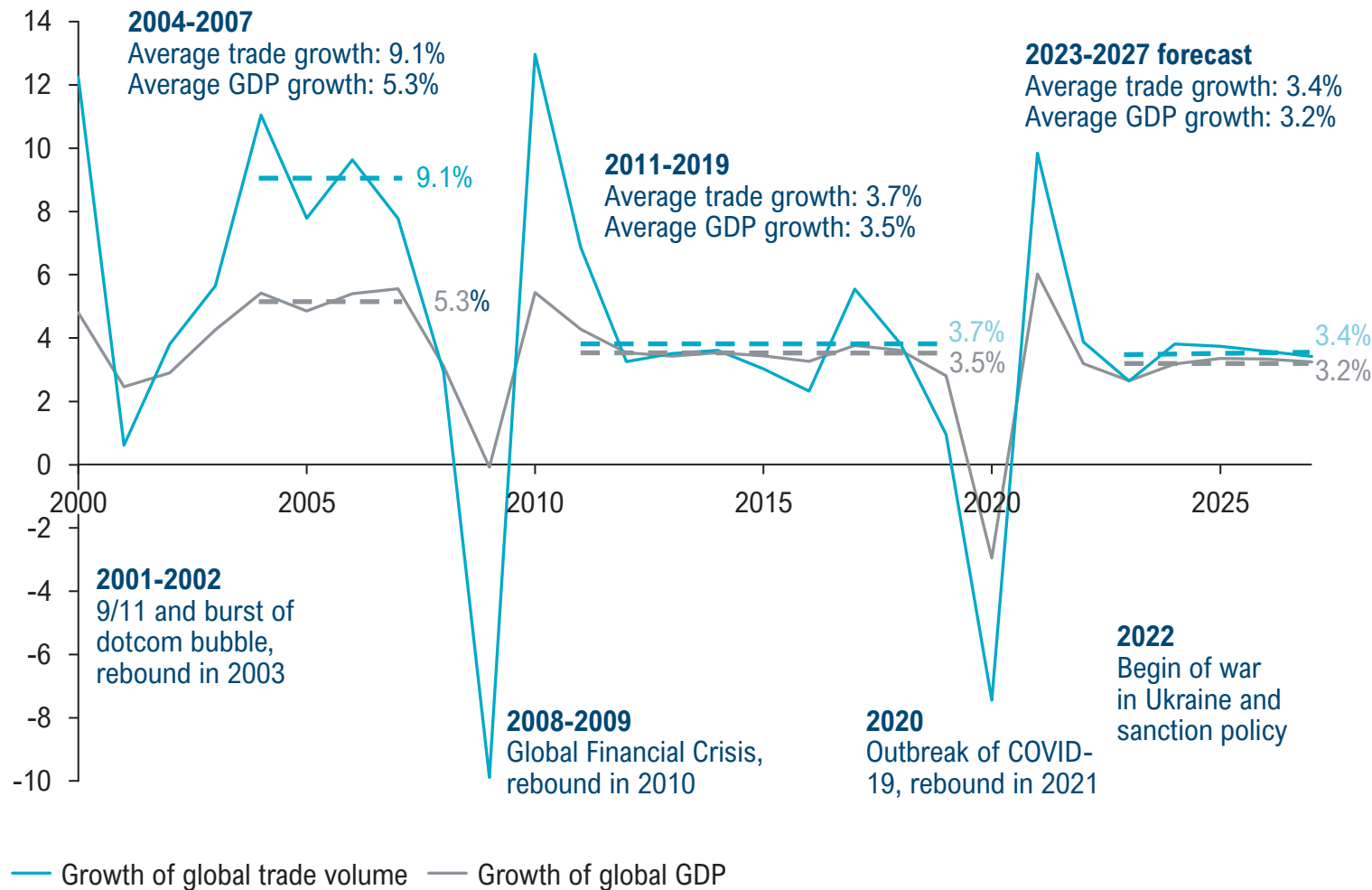
Global value chains are under revision, a new power bloc is emerging, energy transformation is key, pandemic accelerates global debt burden

Subtrends of megatrend "Economics & Business"



Since the Global Financial Crisis, the pace of globalization has slowed and is expected to remain at current levels

Growth of global trade volume¹⁾ and global GDP (real), yoy [%]

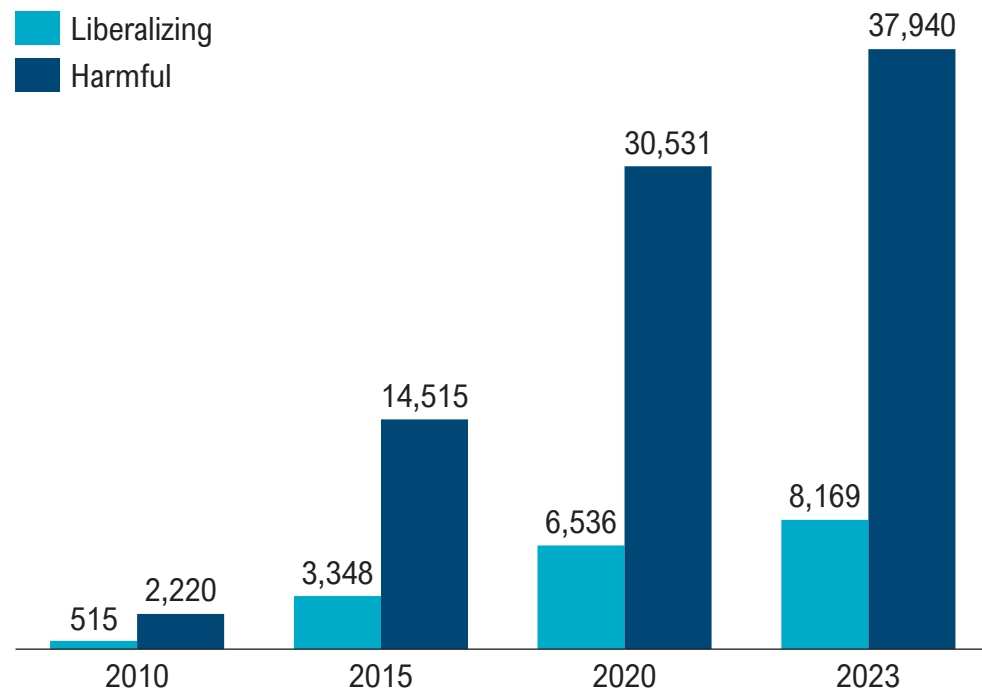


- > The speed of **globalization** (measured as the difference between growth of GDP and trade) **reached its maximum in the mid-2000s**: Between 2004 and 2007, global trade grew, in average, by 9.1% p.a. (compared to 4.5% between 1980-1989 and 6.5% between 1990-1999)
- > **Since the Global Financial Crisis (GFC) 2008/2009, trade growth has declined**: Between 2011 and 2019, global trade – at 3.7% p.a. – grew only slightly stronger than GDP (3.5%). Forecasts for 2023-2027 expect global trade growth of 3.4% p.a. and global annual GDP growth of 3.2%
- > One **reason** for this development is clear: **Globalization is already on a high level**, therefore rates of growth of global trade are closer to rates of growth of global GDP
- > Other reasons are that **China increased its production of intermediate goods** replacing imports, a **weakening of global economic activity after GFC**, and the **increase of trade barriers**

1) Trade volume of goods and services (exports and imports)
Sources: IMF; Roland Berger

As global trade is increasingly burdened by harmful trade interventions and policies, regional trade agreements offer potential to foster trade

Cumulative number of harmful and liberalizing trade interventions, globally 2010-2023



Selected policies and interventions placing a burden on free global trade

Strategic sovereignty policies

- > **China's Dual Circulation Strategy:** putting a stronger focus on domestic consumption. Strategy "**Made in China 2025**" aims to increase the share of domestically produced key materials, thus reducing dependence on foreign suppliers
- > **US Chips & Science Act:** aimed at keeping manufacturing and research of semiconductors in the domestic market, lowering strategic dependence
- > **EU Chips Act:** directed at strengthening domestic EU semiconductor market by reducing the strategic vulnerability from third country imports

Race for green subsidies

- > **EU carbon levy:** promoting greener industry by levying a carbon price tariff on polluting imports, disincentivizing imports from less developed countries
- > **US Inflation Reduction Act:** promoting a greener economy by falling back on protectionist levers to boost domestic industry and energy transition

Geopolitical tensions

- > **Trade wars and sanction policies:** causing fragmentation and bloc formation, disrupting global trade, harming producers and consumers

Potential to foster trade

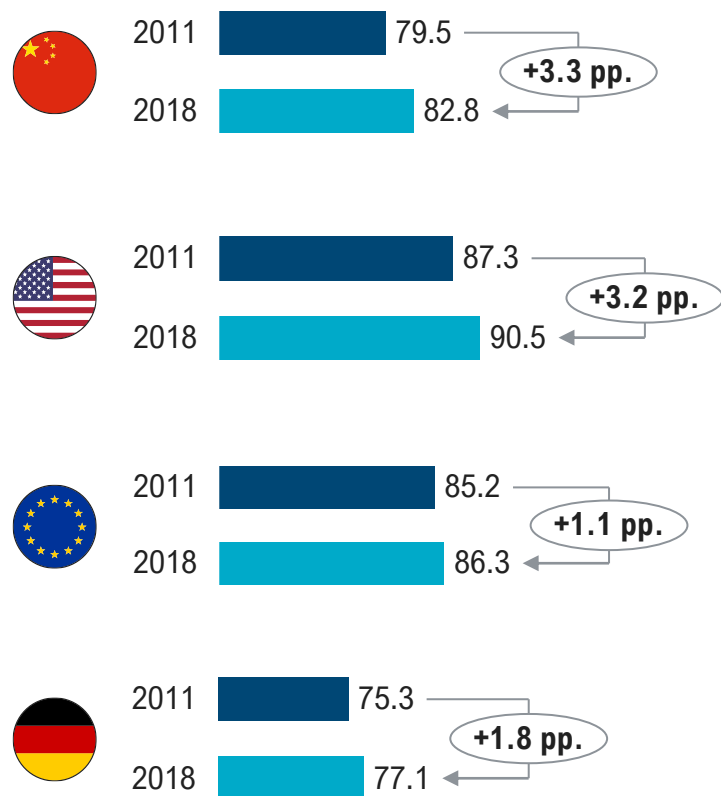
On a **regional level** there are **strong existing institutions and agreements** lowering trade barriers (e.g. EU, USMCA¹), CETA²), RCEP³), AfCFTA⁴), Mercosur⁵), CPTPP⁶) as well as **ongoing efforts to establish new agreements** (e.g. EU-Mercosur, EU enlargement)

1) USMCA = United States-Mexico-Canada-Agreement; 2) CETA = Comprehensive Economic and Trade Agreement (EU and Canada); 3) RCEP = Regional Comprehensive Economic Partnership (Asia-Pacific countries, incl. China, Japan, Australia); 4) AfCFTA = African Continental Free Trade Agreement; 5) Mercosur = South American trade bloc, full members are Argentina, Brazil, Paraguay and Uruguay; 6) CPTPP = Comprehensive and Progressive Agreement for Trans-Pacific Partnership

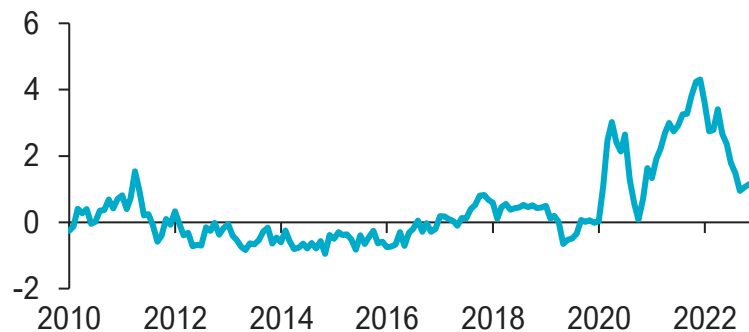
Sources: Global Trade Alert; Roland Berger

In the 2010s, domestic production regained importance in value chains – This trend is set to continue due to a variety of factors

Domestic share of value added as a proportion of a country's/region's total exports 2011 and 2018 [%]



Global Supply Chain Pressure Index 2010-2023



Outlook to 2025: Survey of companies in advanced economies in 2022¹⁾: What % of suppliers do you expect to be nearshored/re-shored on average within the next three years?



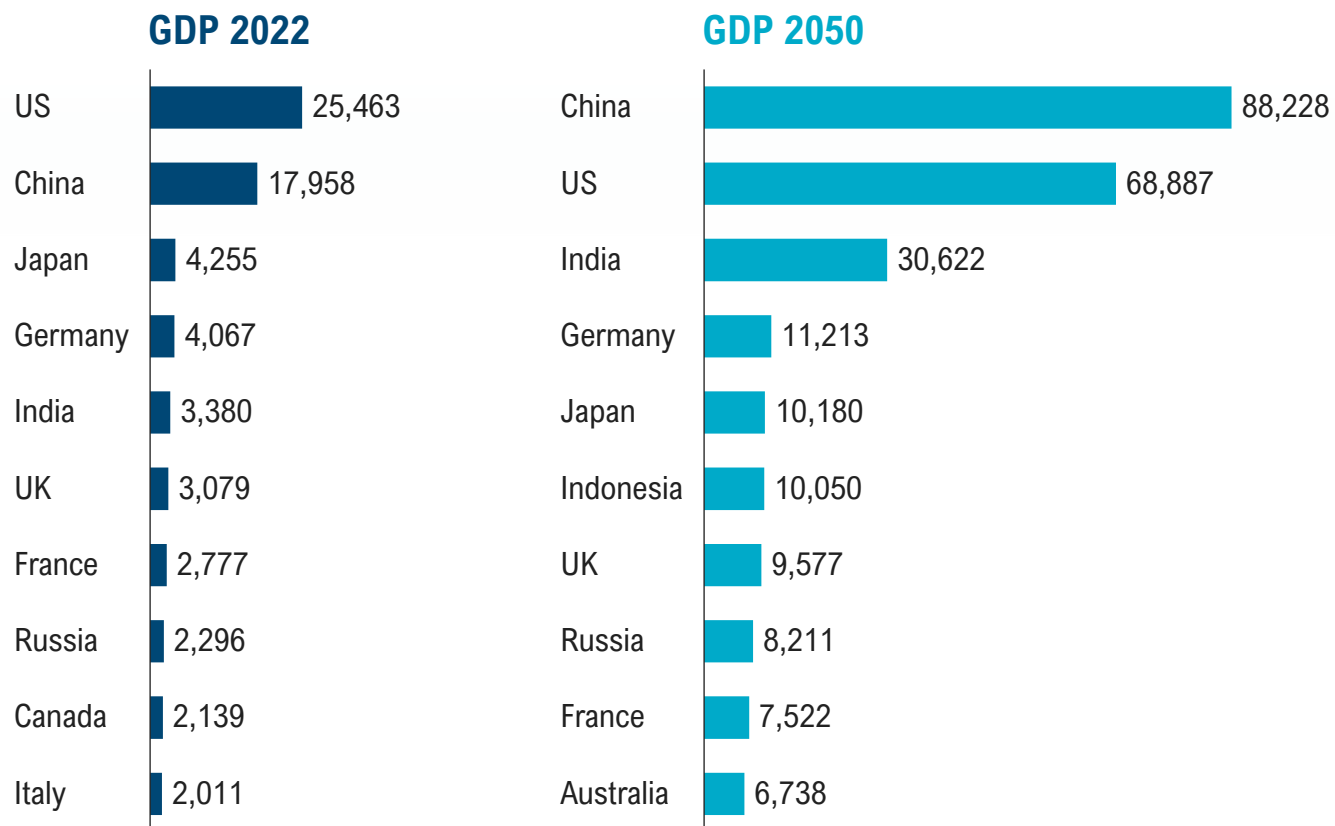
- > In the **2010s**, the **domestic share** of value added of exports **increased** in China, US, EU and Germany for a variety of reasons
- > **China's economy moved up the value chain**, replacing imports of intermediate products with domestic production
- > By contrast, the increases observed in Western advanced economies, such as in the US, EU and Germany, are more likely the result of **policies fostering domestic industries**
- > **Trade tensions, COVID-19, and the war in Ukraine** are putting pressure on current supply chains
- > Therefore, many international companies are revising their supply chain strategy, reconsidering a broader and **more regionalized supplier base**

1) The survey – commissioned by platform provider Interos and conducted by market research company Vanson Bourne – took place from January 22 to March 22 among IT, IT security and procurement decision makers in companies from the US, UK, Ireland, Germany, Austria, Switzerland, France and Canada, and included companies from the following sectors: aerospace and defense, financial services, IT and technology, pharmaceuticals/life sciences, government (central/national)

Global economic power is shifting to emerging countries – Asian countries are poised to take center stage

In 2050, three of the top 6 global economic players will stem from emerging markets in Asia

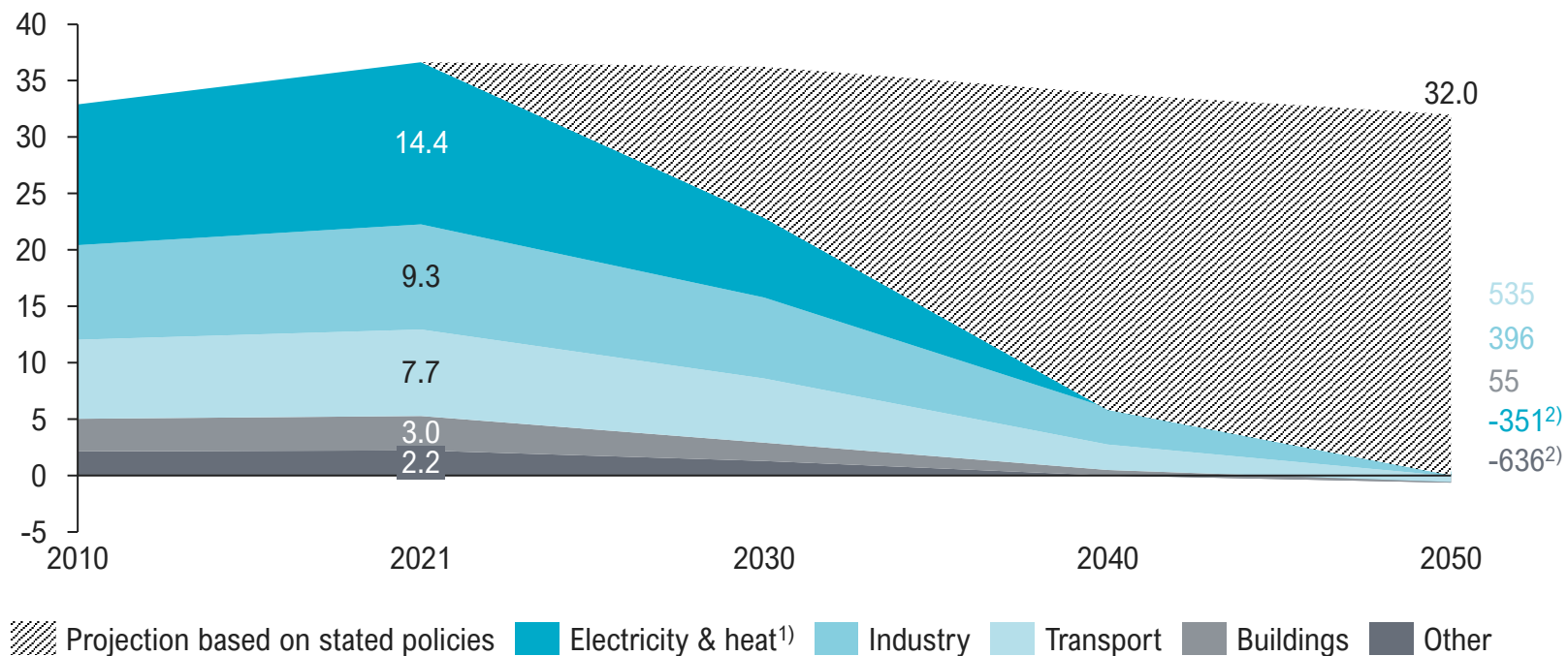
Top 10 countries in terms of nominal GDP in 2022 and 2050 [USD bn]



- > The **Regional Comprehensive Economic Partnership (RCEP)**, a free trade agreement among 15 Asia-Pacific nations (Australia, Brunei, Cambodia, China, Indonesia, Japan, South Korea, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Singapore, Thailand, Vietnam) formally signed in 2020, has demonstrated the ambitions of Asian countries to **leverage their economic potential**
- > Comprising a broad range of **fast growing developed and emerging economies** and **important advanced economies**, a **large potential of skilled labor** and a **giant customer base** with rapidly increasing purchasing power, many Asian countries are already **economic powerhouses** while others are on a clear path to become one in the future
- > **India** has become the **most populous country in 2023** and **China** will likely replace the United States as the **world's largest economy by 2033**. By 2050, **three of the top 6 global economic players** will stem from emerging markets in Asia
- > **RCEP** is a competitive force amongst free trade areas, but equally a **new opportunity** for its members and other trading blocs: the agreement may make it **easier for other free trade areas to trade with the Asia Pacific states**, as it can reduce or replace the number of (existing) bilateral or country-level agreements

Today, economic development can no longer be understood without climate change considerations – To achieve net zero, all sectors must contribute

Global CO₂ emissions by sector in the Net Zero Emissions Scenario vs Stated Policies Scenario [Gt CO₂]



Stated Policies Scenario

- > Outlines the emissions reduction goals that countries have **already announced**
- > Assumes that countries **continue to implement policies** that are **currently in place**, such as emission targets set out in international agreements

Net Zero Emissions Scenario

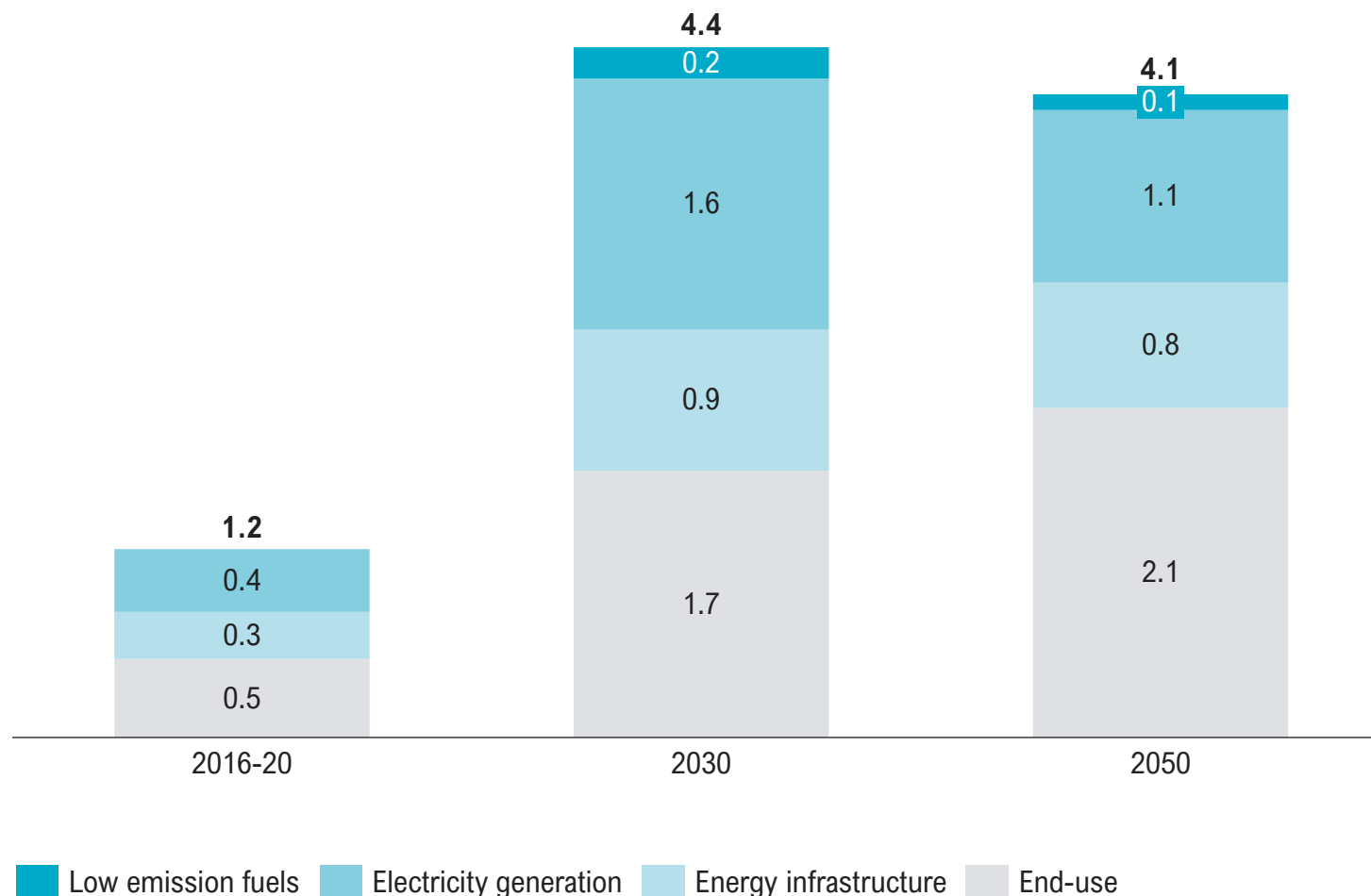
- > Sets out a **path to reach global net zero emissions by 2050**
- > Assumes **that all countries** implement **ambitious policies** to reduce emissions from **all sectors**, including energy, industry, buildings, transport, and land use

- > With global temperatures continuing to rise and the effects of climate change becoming increasingly evident, **reducing emissions from all economic sectors is essential** in order to mitigate the worst of these effects and create a more sustainable future
- > To achieve the goal of net zero emissions by 2050, the **transformation of the power and heat generation sector** must take place **faster** than **other sectors**, as the former is to be electrified extensively and therefore **relies on vast amounts of green electricity**

1) Includes emissions from industrial processes and flaring; 2) By 2050, the increased use of bioenergy with carbon capture and storage (BECCS) is expected to offset the CO₂ emissions of other sectors and thus become negative. Carbon removals and capture further contribute to reducing emissions with negative CO₂ emissions

Massive investment is necessary to achieve the ambitious goal of net zero by 2050 – Job creation in the clean energy sector and upskilling are key

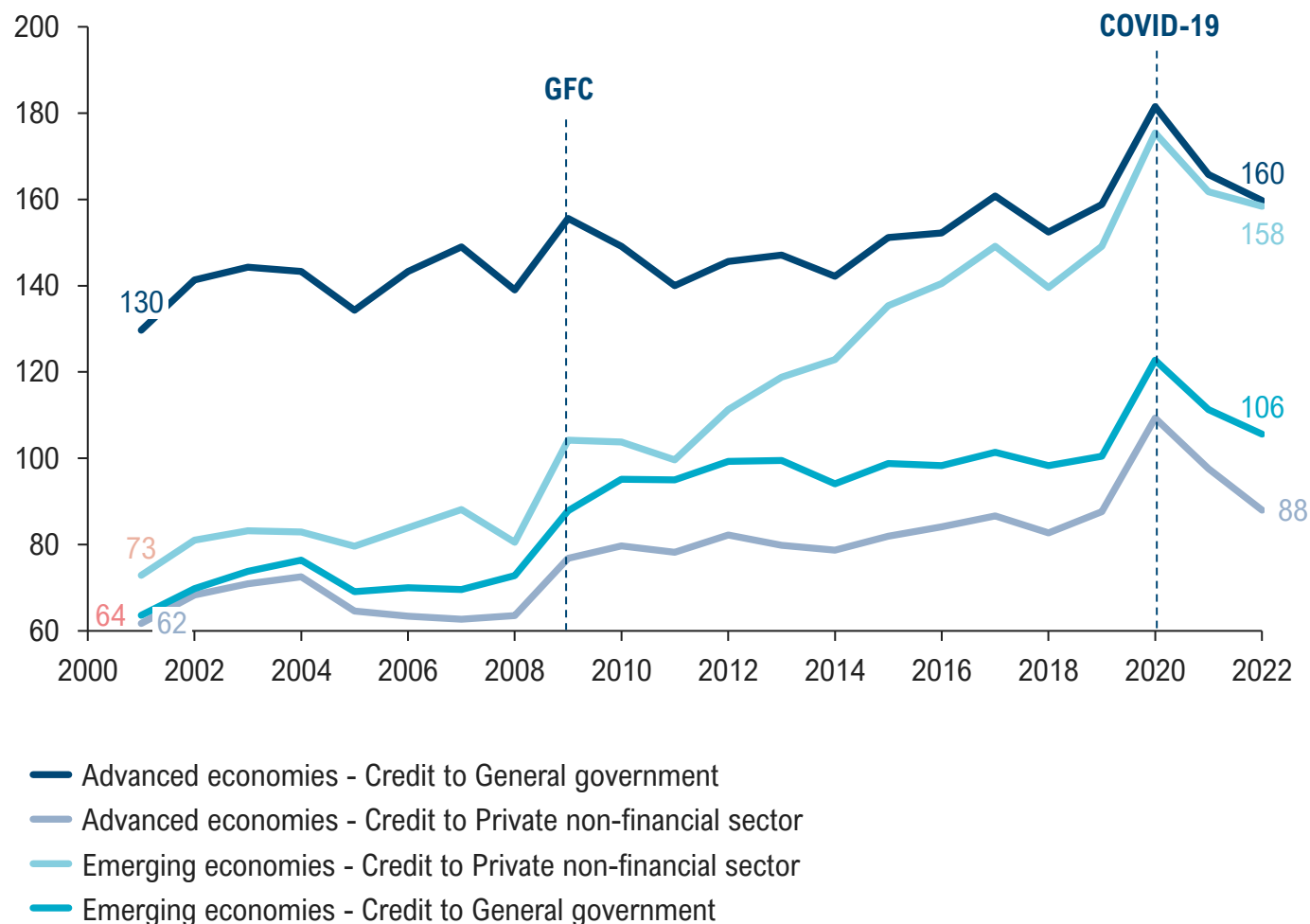
Breakdown of global annual investment volumes needed on the way to net zero till 2050 [USD trillion]



- In order to achieve the ambitious target of reaching net zero by 2050, **considerable investment is required**. Annual clean energy investment needs to more than triple by 2030, thereby driving an average 0.4% p.a. increase in global GDP
- The IEA estimates that pursuing the target of net zero will **create 14 million new clean energy jobs** by 2030, while another **16 million workers shift to new roles** related to clean energy
- Around 60% of these new jobs **require some degree of post-secondary training**, making **improvements in education** a necessity for many countries
- Especially investment in **electricity generation requires rapid growth**. As of today, renewable energy sources such as wind or solar power plants account for around 10% of global electricity generation

Financially, the global economy is burdened by increasing levels of debt – Debt levels rose more sharply in emerging economies

Development of credit as a percentage of GDP^{1,2,3)} [%]



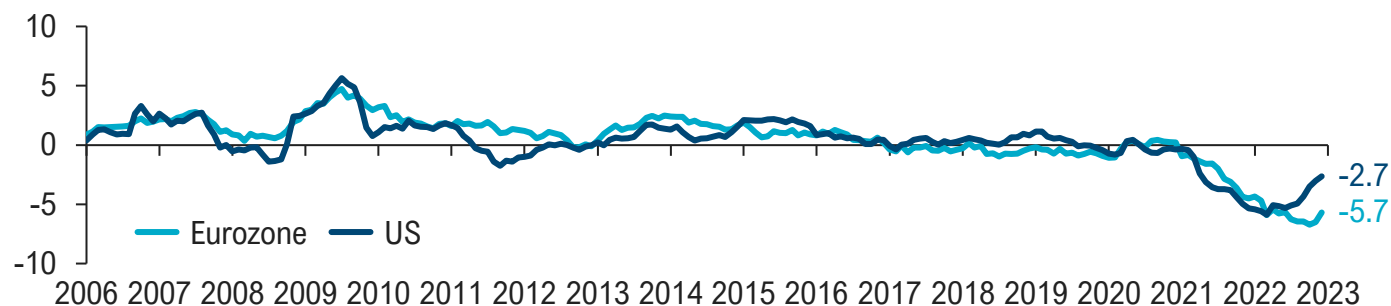
- In recent decades, **debt has increased sharply** worldwide. To preserve economic stability and social cohesion, general governments were faced with raising large amounts of finance to support their national fiscal programs following historic events such as the financial crisis or the pandemic, but also to fund infrastructure projects and social programs
- To foster growth after the financial crisis, fiscal responses were supported by a **far-reaching easing of monetary policy**, thereby lowering interest rate levels also for the private sector, making borrowing cheaper
- The strong increase in credits to the private non-financial sector in **emerging economies** shows that these countries are **climbing the economic development ladder**
- Due to the war in Ukraine, the rearmament announcements in many European countries, the need to rebuild Ukraine once the war ends, and giant investment in the green energy transition, there is likely to be a **considerable need for investment in the future** as well – meaning, it can be assumed that **debt will continue to rise** in the future

1) Sum of credit to general government and private non-financial sector, including corporates and households; 2) Credit to private nonfinancial sector is measured in market values whereas government debt is measured in nominal terms; 3) Data of the 4th quarter is used for each year besides 2022, where Q2 data is the most recent available data

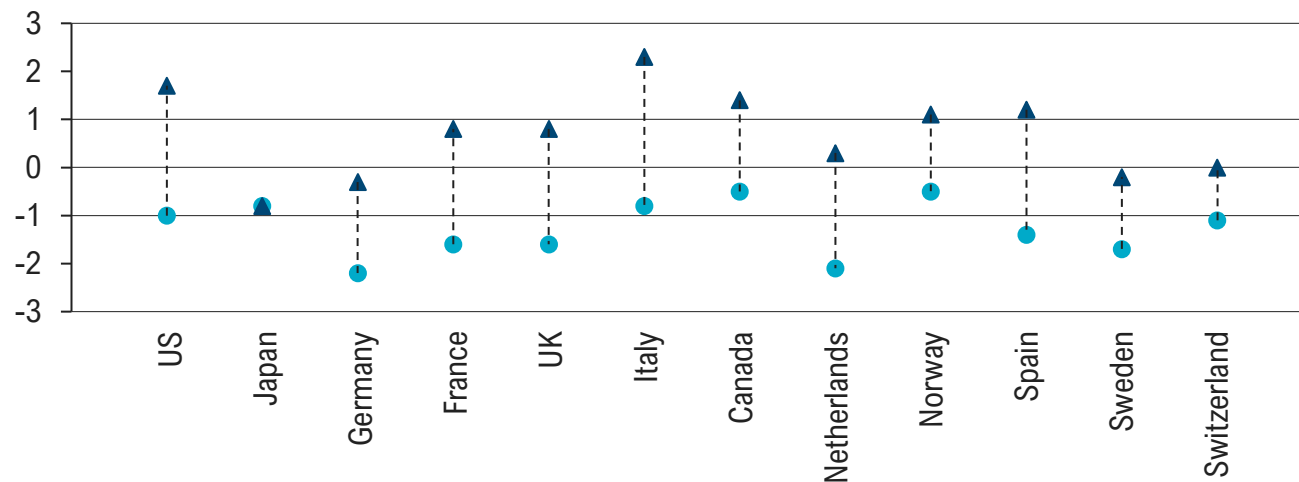
Sources: Bank for International Settlement; Roland Berger

In the long run, analysts expect real interest rates to turn positive once more posing a potential debt challenge for governments

Long-term real interest rates in selected economies^{1,2)} [%]



Long-term real interest rate expectations^{1,2)} [%]



● Analysts long term expectations as of Nov 21 ▲ Analysts long term expectations as of Nov 22

- In **recent years**, long-term interest rates in industrialized countries, and especially in the increasingly integrated G7 capital markets, **have been converging toward low or even negative levels**
- **Adjusted for inflation, real long-term interest rates** in the major industrialized countries were broadly **negative** and most analysts expected that negative real interest rates would persist in the future
- However, this has **changed over the course of 2022** due to **soaring inflation rates** and **central banks** across the globe aggressively **hiking rates** compared to prior years – with longer-term **bond market yields responding** in turn
- While real interest rates **are still negative** in most industrialized countries, analysts' **long-term expectations** indicate that real interest rates could again **exceed the 0% threshold** in the long term
- In the event of positive real interest rates, it will become **more difficult** to **steer the countries' elevated debt levels** in a sustainable manner

1) Nominal 10-year bond yields deflated using 10-year inflation forecasts, like for like inflation adjustment 2023-2032
 2) The calculation of real interest rates is derived from the Fisher equation, namely $(1+r) = (1+i)/(1+\pi)$, where r is the real rate, i is the nominal rate and π is the expected inflation rate
 Sources: Consensus Economics; Federal Reserve Bank of St. Louis; Roland Berger

Main sources

Megatrend 4 – Economics & Business

International Monetary Fund (IMF): World Economic Outlook 10/2022. <https://www.imf.org/en/Publications/WEO/weo-database/2022/October>

Global Trade Alert: Global Dynamics. https://www.globaltradealert.org/global_dynamics

OECD: Trade in Value Added (TiVA) 2018ed. https://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2018_C1

Federal Reserve Bank of New York: GSCPI. <https://www.newyorkfed.org/research/policy/gscpi#/overview>

Interos: Resilience 2022 – The Interos Annual Global Supply Chain Report. https://www.interos.ai/wp-content/uploads/2022/05/Resilience-2022_Interos_Annual-Global-Supply-Chain-Report_5_11_2022.pdf

Oxford Economics: Global Macro Database. <https://my.oxfordeconomics.com/reports?Cat0=4452>

IEA: World Energy Outlook 2022. <https://www.iea.org/reports/world-energy-outlook-2022>

IEA: Clean Energy Investment 2016-2050. <https://www.iea.org/data-and-statistics/charts/clean-energy-investment-in-the-net-zero-pathway-2016-2050>

International Renewable Energy Agency (IRENA): World Energy Transitions Outlook 2022. <https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022#page-2>

Bank of International Settlements: BIS Statistics, retrieved May 2023. [https://stats.bis.org/#df=BIS:WS_TC\(2.0\);dq=.4T+5A+5R.P...%3FlastNObservations=6;pv=1,3,5~7~0,0,0~name](https://stats.bis.org/#df=BIS:WS_TC(2.0);dq=.4T+5A+5R.P...%3FlastNObservations=6;pv=1,3,5~7~0,0,0~name)

Consensus Economics: Consensus Forecasts (RB subscription), retrieved May 2023. <https://www.consensuseconomics.com>



4.1
Global Trade
& Value Chains



4.2
Power
Shifts



4.3
Energy
Transformation



4.4
Debt
Challenge



Megatrend 5

Technology & Innovation



Technology investment and innovation capabilities remain key – AI promises vast future potential but raises concerns for human values

Subtrends of megatrend "Technology & Innovation"

1



Value of Innovation

2



Frontier Technologies

3

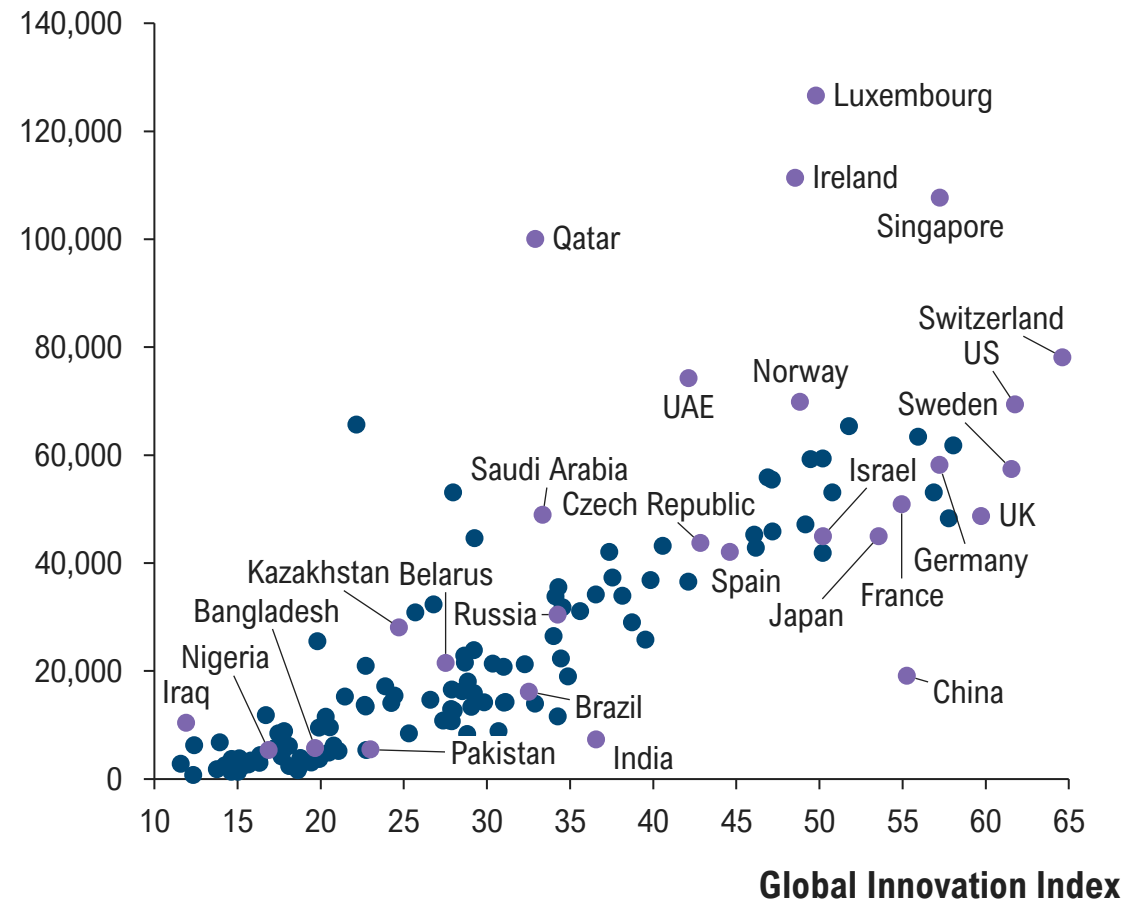


Humans & Machines

Technology and innovation drive prosperity – Many developing countries lack abilities and access to catch up with developed countries

WIPO Global Innovation Index (GII) 2022 related to GDP per capita PPP in 2022 [Index, USD]

GDP per capita PPP [USD]

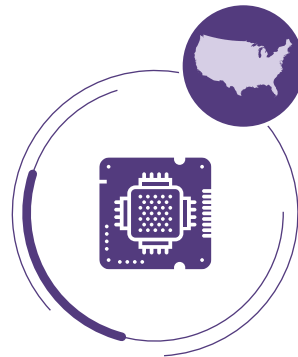


- > The **innovative** capability of a nation is an essential engine of **productivity, growth, and prosperity**
- > The **Global Innovation Index (GII)** ranks **countries** from 0 to 100 based on their **ability to innovate**. The index analyzes countries along a **variety of metrics**, including R&D intensity, patent applications, tertiary education efficiency, regulatory environment, productivity, high-tech density, and researcher concentration
- > Evaluating the Global Innovation Index from a GDP/capita perspective, there is a clear message: **the higher (lower) countries score on innovation the higher (lower) their GDP/capita**. China is an exception in having successfully built up its innovation strength, yet the country still has a lower GDP/capita than developed countries
- > Many **developing countries lack abilities and access regarding institutions and skills** to close the technology and innovation gap. Established networks of higher education and research institutions as well as a significant number of technology companies involved in high-end R&D – both evidenced in developed countries – are notably absent
- > To gain a broad picture of a country's innovation capabilities, different innovation indices should be used. In addition to the GII, the new **"Innovation indicator"**, an innovation index jointly developed by **Roland Berger, BDI, Fraunhofer and ZEW**, dives deeply into the topic. It measures the **innovation capability of 35 developed and emerging markets**. Criteria are the **ability to produce innovations**, the position in **key technologies** and the strength in terms of **sustainability**¹⁾

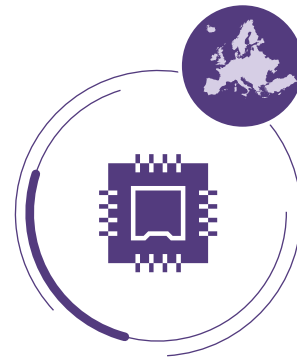
1) See BDI, Fraunhofer ISI, Roland Berger, ZEW: Innovationsindikator 2023
Sources: WIPO; World Bank; Roland Berger

Leading nations and global companies plan to invest heavily in technology – A particular focus concerns chipmakers

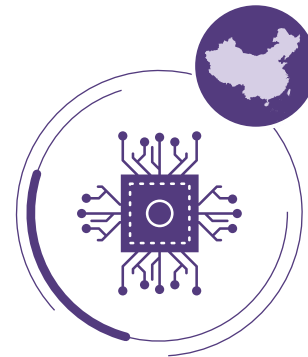
Selected investments in technology



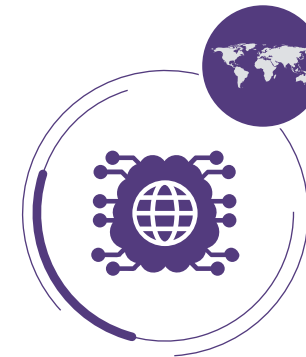
US Chips & Science Act to invest **USD 248 billion** into semiconductors and R&D spending until 2026



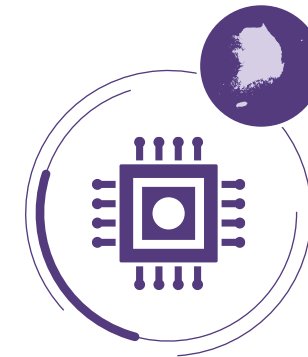
EU Chips Act mobilizes **EUR 43 billion** for research and semiconductor manufacturing by 2030



China is readying a **USD 143 billion** package for its **semiconductor industry** allocated over 5 years



Global IT investments in artificial intelligence to surpass **USD 300 billion** in 2026



Samsung to invest **USD 151 billion** until 2030 in its **chipmaking facilities**



Volkswagen intends to invest **USD 193 billion** in **EV and battery production** until 2028



5.1
Value of Innovation



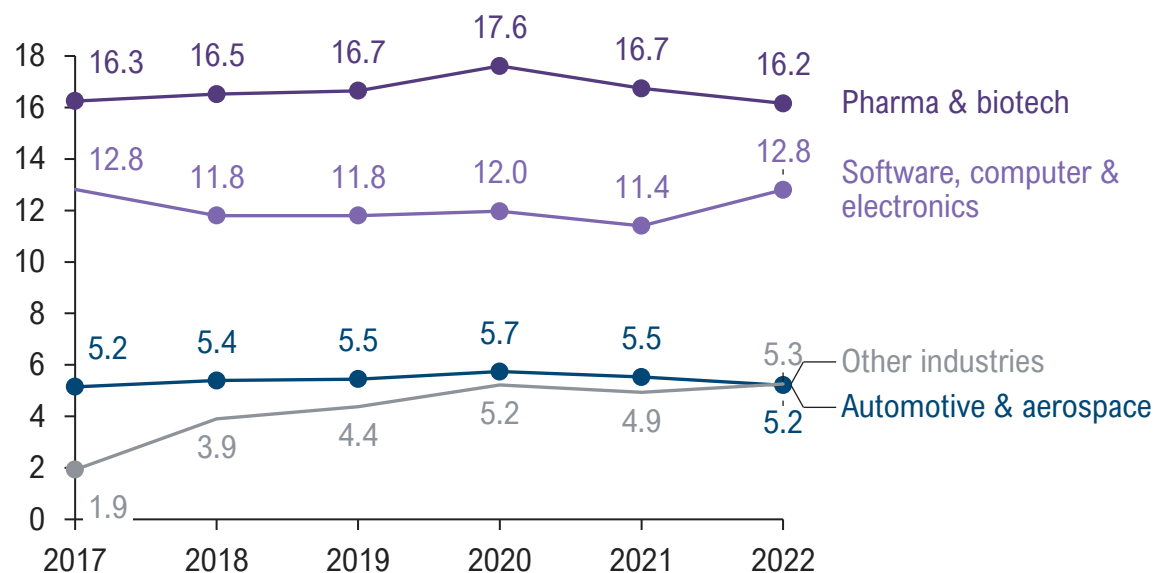
5.2
Frontier Technologies



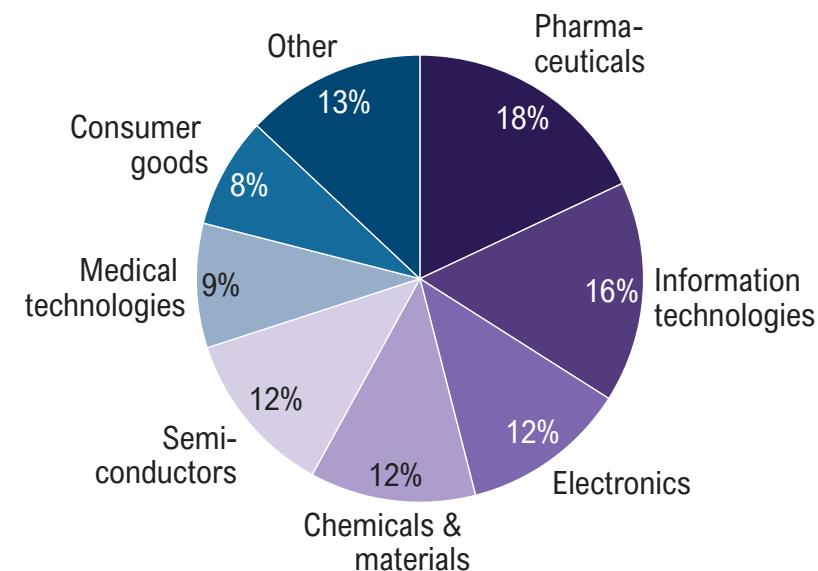
5.3
Humans & Machines

Pharma and Software account for the highest share of R&D expenditure relative to their revenue, thereby leading as most innovative sectors

R&D intensity by economic sector in companies from selected OECD countries^{1,2,3)} [%]



100 most innovative companies, globally, share by industry sector⁴⁾ [%]



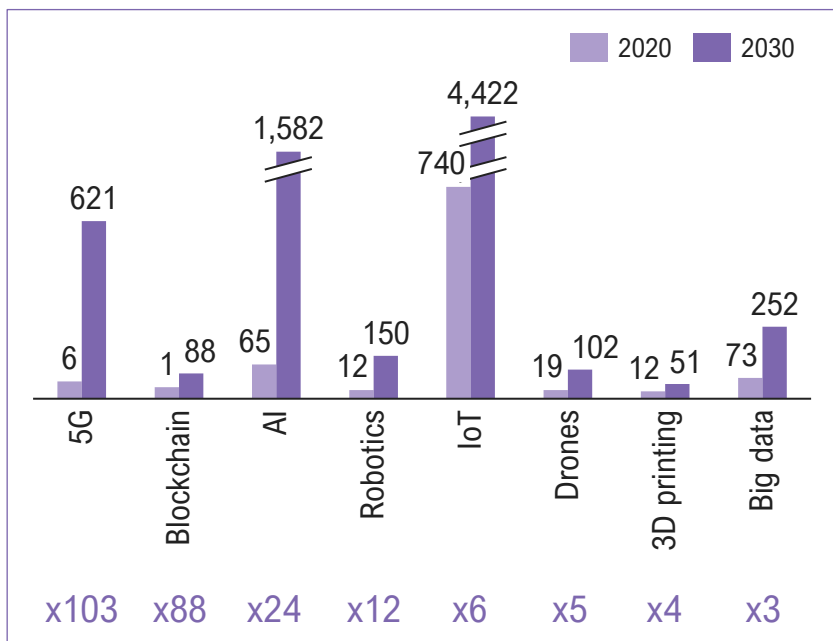
- > **Research and development (R&D)** constitutes the area of a company's operations that pursues knowledge to **develop, design, and improve** its products, processes, technologies, or services. It is an important **driver of economic growth** spurring innovation, invention, and progress
- > By investing in R&D, companies seek to improve existing products and develop new ones in order to **remain competitive, capture new markets,** and develop **new revenue streams**
- > In recent years, companies from the **pharma & biotech** and from the **software, computer & electronics sectors** recorded a particularly high share of R&D spending as a percentage of revenue – precisely these sectors also account for the **highest share of the 100 most innovative companies**

1) Adjusted for OECD inflation 2) The OECD database contains R&D expenditure taken from company reports for a sample of 60 companies across 14 countries, consisting of the 50 top R&D performers in the world featured in the 2020 EU Industrial R&D Investment Scoreboard, plus a selection of 10 other companies known as leaders in their sector 3) Defined as the share of R&D expenditures in the company's revenues 4) The Innovation Momentum Report by Lexis Nexis identifies the top 100 companies according to the size and quality of their patent portfolio

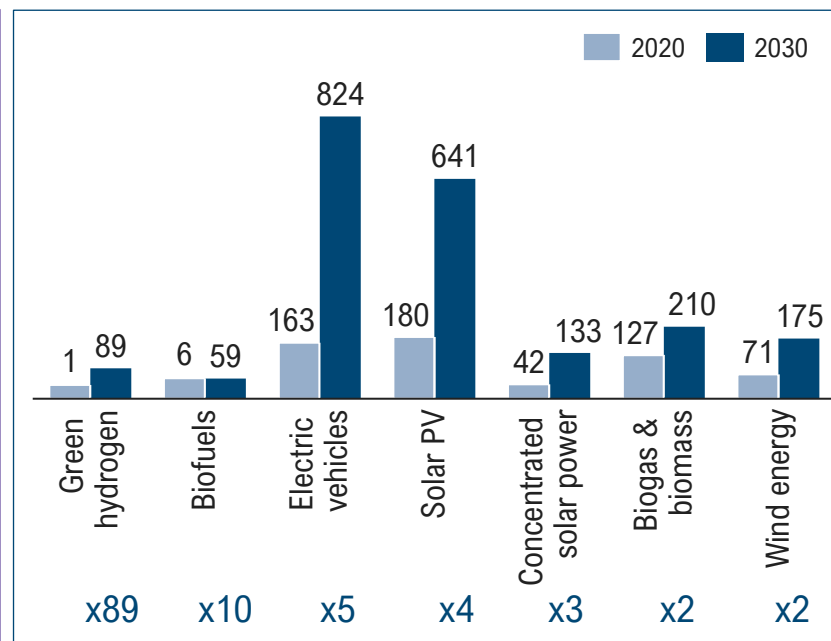
Today's frontier technologies are expected to experience considerable growth, maturing to a market value of USD 9.5 trillion by 2030

Global market size estimates of frontier technologies 2020 and 2030 [USD bn]

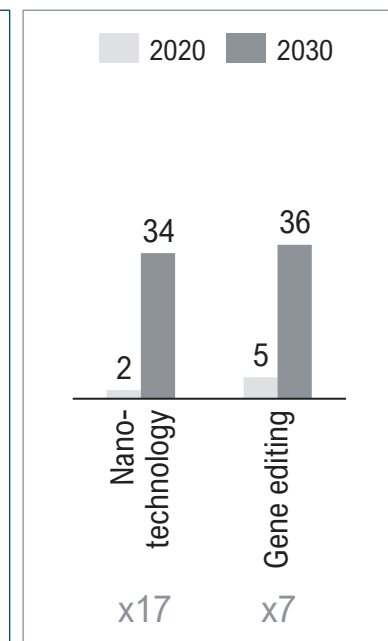
Industry 4.0 frontier technologies



Green & renewable energy frontier technologies



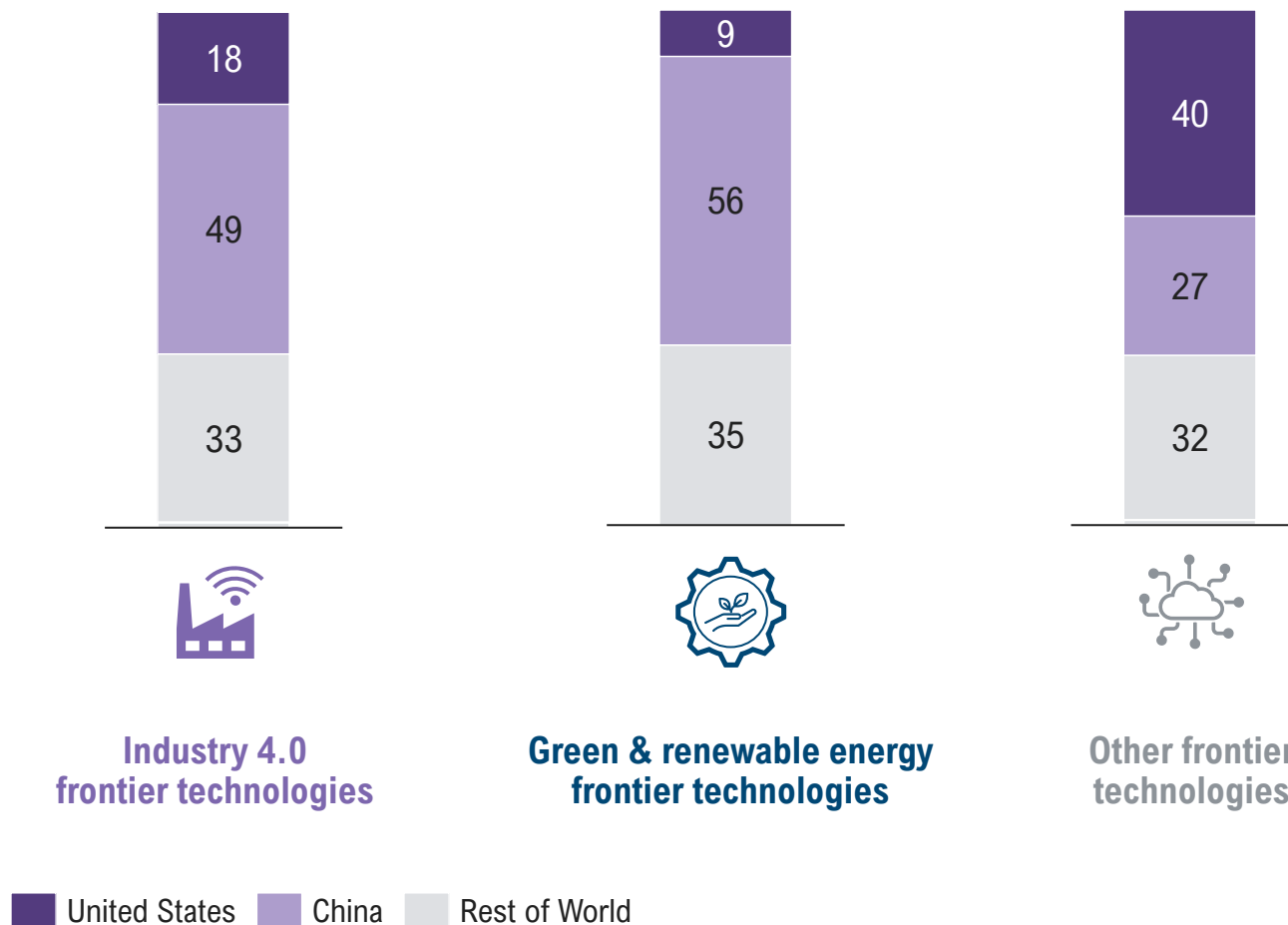
Other frontier technologies



- > In its Technology and Innovation Report 2023, UNCTAD defines **17 new and rapidly developing technologies that take advantage of digitalization and connectivity**
- > **These frontier technologies** can be classified into **three broad categories**: Industry 4.0, green & renewable energy, and others
- > In some cases, these **categories intersect**. For example, drones are not classified as green frontier technology; however, using delivery drones allows for a reduction in GHG emissions since the energy consumption per load is lower compared to other means of delivery

China and the US are dominating the global landscape of frontier technology patents








Global country share of patents, by frontier technology 2000-2021 [%]



- > A crucial **indicator** measuring and comparing national **R&D efforts** is the **number of patents in frontier technologies**
- > Among **investors and scientists**, frontier technologies have **generated increasing interest** over the past two decades – the related **number of patents** has **skyrocketed**. Patents in areas of biogas/biomass, AI, electric vehicles and IoT account for the largest amount of patents
- > The **knowledge landscape** for new fields of technology is **dominated by China and the United States**, together holding two thirds of global frontier technology patents
- > However, it is vital to note that the **quality of patents is equally important**. This can be measured by the international scope of patents, the grant ratio (filed patents/granted patents) as well as the commercialization rate of patents. Under such criteria, China's performance is lower than major developed countries

However, in terms of research for most of today's critical technologies, China is taking the academic lead

Countries and their position regarding critical fields of technology^{1,2)}

Field of technology	# of subsumed technologies	🇨🇳		🇺🇸	
		ranks 1 st	ranks 2 nd	ranks 1 st	ranks 2 nd
 Advanced materials & manufacturing	12	12/12	0/12	0/12	9/12
 AI, computing & communications	10	7/10	3/10	3/10	7/10
 Energy & environment	8	8/8	0/8	0/8	6/8
 Quantum	4	3/4	1/4	1/4	3/4
 Biotechnology, gene technology & vaccines	3	2/3	1/3	1/3	2/3
 Sensing, timing & navigation	1	1/1	0/1	0/1	1/1
 Defense, space, robotics & transportation	6	4/6	2/6	2/6	4/6
Total	44	37/44	7/44	7/44	32/44

- > Australian Strategic Policy Institute's Critical Technologies Tracker monitors a relevant **set of high impact academic output for 44 selected critical technologies** crucial to **economic competitiveness and national security**¹⁾
- > These **critical technologies** span areas of defense, space, robotics, energy, biotechnology, advanced materials, artificial intelligence, quantum technology, and the environment
- > **Western democracies are losing competitive ground** in the global technological race: **China** has positioned itself as the world's **leading science and technology superpower**
- > In **37 out of the 44** critical technologies, **China leads** in terms of **high-quality research output** – indicating that China's scholarly research accounts for the highest share of the top publications in a technological field

1) Database queries identified the relevant set of papers for each technology (2.2 million in total); ranking based on the top 10% most highly cited research publications of the past five years on each of the 44 technologies; 2) Most recent data as of March 2023

Sources: ASPI; Roland Berger

Artificial intelligence is seen as a powerful but also risky frontier technology – Experts expect human-level AI within next 100 years

2022 Expert Survey on Progress on AI

When will unaided machines be able to accomplish every task better and more cheaply than human workers?



90%
of experts

... expect – with a 50% chance – that unaided machines will perform better and more cheaply in every task than human workers within the next 100 years

80%
chance

... that the rate of global technological improvement will dramatically increase in the next 30 years as a result of existing high-level machine intelligence (HLMI)

5%
probability

... that the long-run effects of advanced AI on humanity will be "extremely bad", e.g. human extinction

- > While stating an exact date for the **existence of human-level AI** (i.e. AI that can accomplish every task better and more cheaply than human workers) is near impossible, a survey of experts has tracked and analyzed their views regarding AI with a view to the century ahead
- > With the most recent advances in computing power and AI, experts have readjusted their estimates in the last few years; now, **90%** (2018: 81%) of **experts anticipate the existence of human-level AI within the next 100 years** – and 50% expect it even before 2061
- > AI **experts stress** especially the tremendous **risks of ungoverned and rogue AI**. In this survey, they have evaluated disastrous long-run effects (such as human extinction) with a 5% probability

We asked different AIs on their view of the future of AI – and got some interesting answers

What does the future of AI look like? Please answer in 3 sentences

Open AI

1. The future of AI looks incredibly promising, with continued advancements in machine learning, natural language processing, and computer vision
2. AI will become increasingly integrated into our daily lives, impacting everything from healthcare and transportation to entertainment and education
3. However, there are also concerns about the potential negative impacts of AI, including job displacement, privacy concerns, and bias in algorithms

AskBrian

1. The future of AI is exciting and full of potential
2. It promises to drastically improve the way we live and work by making tasks easier, faster, and more efficient
3. AI will be used in a wide range of applications, from healthcare to transportation, to create smarter and more efficient systems that can automate mundane tasks and allow us to focus on more important and meaningful work

Bard AI

1. The future of AI looks bright, with the potential to revolutionize many industries and aspects of our lives
2. AI is already being used to automate tasks, improve efficiency, and make better decisions
3. It is likely to continue to evolve and become even more powerful in the years to come

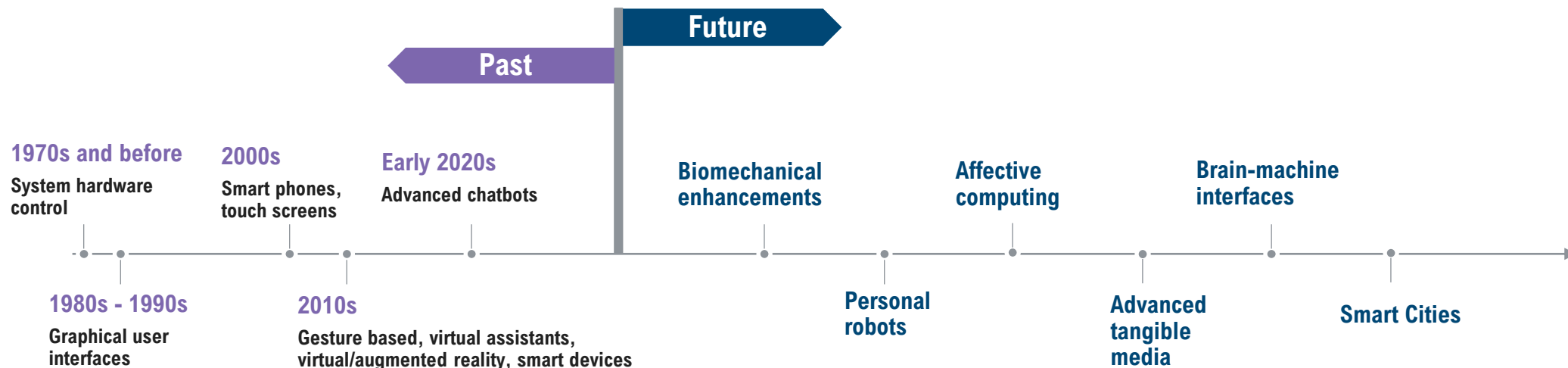


Did you know?

OpenAI's ChatGPT3.5 is one of the fastest adopted technologies, reaching 100 million users within 2 months after launch. By contrast, TikTok took 9 months to reach this milestone

New technologies affect the relationship of humans and machines – Having evolved greatly over past decades, more milestones lie ahead

Development of human-machine interaction



- > **Human-machine interaction (HMI)** has been an area of research and innovation since the 1970s, when computers first began to be used in everyday life. Since then, progress in HMI technology has accelerated to meet the changing needs of users. Then, computers were large and expensive devices that were highly complex and difficult to use. To overcome this, early HMI technology focused on increasing the usability of computers, e.g. by developing graphical user interfaces (GUIs)
- > User interfaces as well as the interaction between human and machines have since become greatly simplified and accessible, e.g. through the adoption of touch screens and virtual assistants such as Apples' Siri or AI-powered chatbots like ChatGPT. Today, humans interact with a vast number of smart devices connected to the Internet such as heating or lighting systems. The Internet of Things (IoT) has arrived – and is likely to gain further importance in the future, e.g. in Smart Cities where human-machine interaction will become ubiquitous
- > In the future, biomechanical enhancements, such as exoskeletons, will enhance human physical capability, personal robots will collaborate with people using language or non-verbal cues, affective computing can respond intelligently to natural human emotional feedback, and advanced tangible media will enable humans to remotely interact with others using all senses (and even with people no longer with us through means of tangible memories)
- > The direct connection of human and machine (brain-machine interface) will not be science fiction for much longer either: research into bionic humans is already at an advanced stage. Plans also include to implant chips into people's brains so that machines can be controlled with their minds (a danger, of course, lurks in the opposite direction). Globally, there are already thousands of people with microchips implanted in their hands, which can be used for paying, storing medical data or enabling access to password protected systems. The technology-savvy country Sweden has the largest share of such cyborgs

AI particularly touches the human-machine relationship – There is a broad debate about risks and opportunities of AI and how to cope with them ...

Selected expert views on AI

Sundar Pichai
CEO of Alphabet

"[AI is] more profound than fire, electricity or anything we have done in the past."

Bill Gates
Bill and Melinda Gates Foundation

"Just as the world needs its brightest people focused on its biggest problems, we will need to focus the world's best AIs on its biggest problems."

Tim Berners-Lee
Inventor of the World Wide Web

"As long as human beings remain firmly in control of assets in the physical world, it's going to be hard for a hostile AI to do too much damage."

Geoffrey Hinton
"Godfather 1 of AI"

"I think we should continue to develop it [AI] because it could do wonderful things. But we should put equal effort into mitigating or preventing the possible bad consequences."

Open Letter 2023
Future of Life Institute

"AI systems with human-competitive intelligence can pose profound risks to society and humanity (...). Advanced AI could represent a profound change in the history of life on Earth and should be planned for and managed with commensurate care and resources."

Several AI experts, Statement on AI Risk
Center for AI Safety

"Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war."

Yoshua Bengio
"Godfather 2 of AI"

"If they [the AI systems] are smarter than us, then it's hard for us to stop these systems or to prevent damage."

Stuart Russell
Berkeley University

"The algorithms don't care what opinions you have. They just care that you're susceptible to stuff that they send. But of course, people do care."

Santiago Valderrama
Machine Learning engineer

"AI will not replace you. A person using AI will."

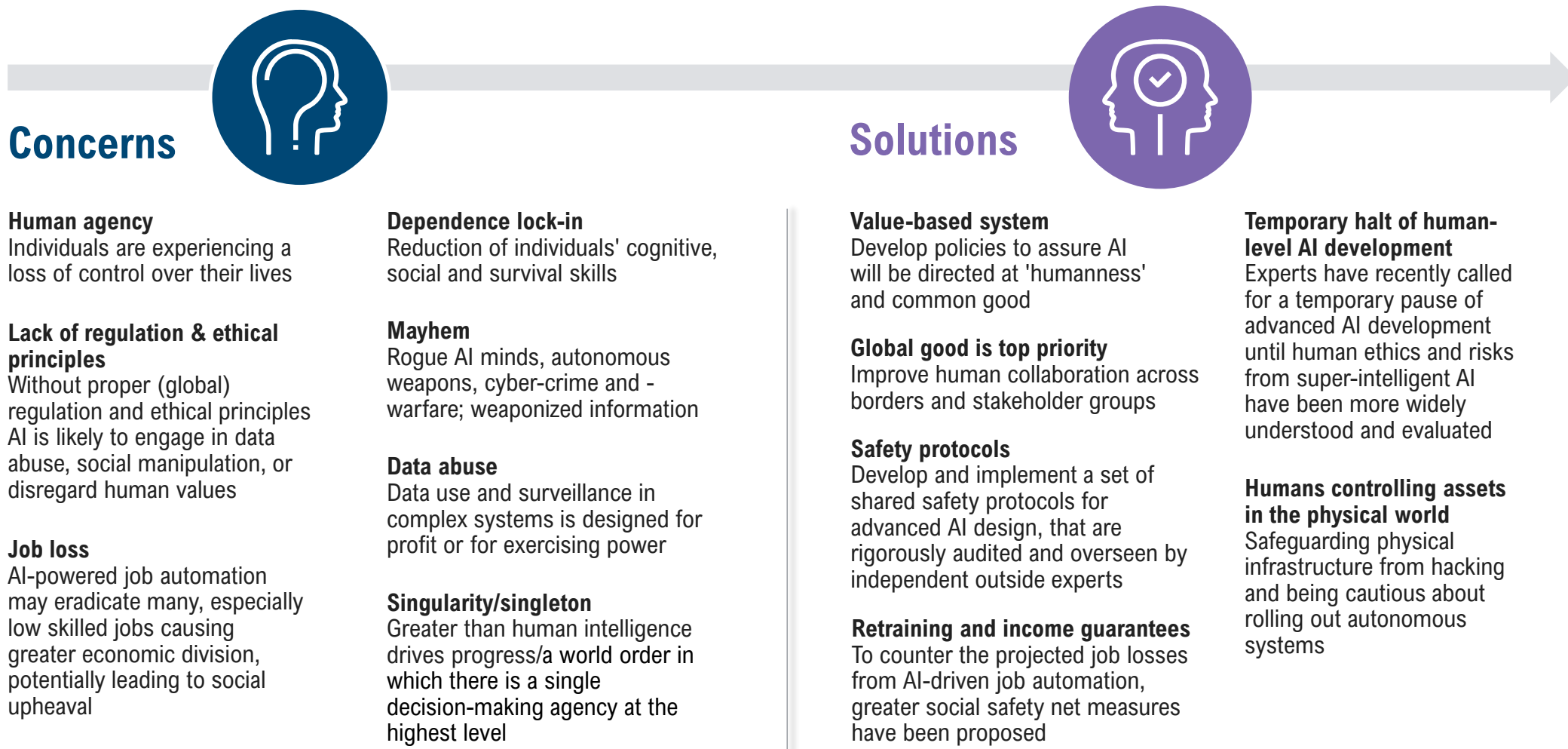
Nick Bostrom
Oxford University

"(...) consider a super intelligent agent that wanted to maximize the number of paperclips in existence (...). It might then want to eliminate humans to prevent us from switching it off. It might also want to use the atoms in our bodies to build more paperclips."



... which can be summed up in a set of concerns and possible solutions

AI and the future of humans – Selected concerns and solutions



Main sources

Megatrend 5 – Technology & Innovation

World Intellectual Property Organization (WIPO): Global Innovation Index 2022. <https://www.wipo.int/publications/en/details.jsp?id=4622>

World Bank: Scientific and technical journal articles, retrieved May 2023. <https://data.worldbank.org/indicator/IP.JRN.ARTC.SC>

R&D Magazine: Global gross expenditures on R&D, 2022. <https://www.rdworldonline.com/2022-global-funding-forecast-rd-variants-cover-more-than-the-pandemic/>

OECD: SwiFTBerD Dashboard 2023. <https://oecd-main.shinyapps.io/swiftberd/>

United Nations Conference on Trade and Development (UNCTAD): Technology & Innovation Report 2023. https://unctad.org/system/files/official-document/tir2023_en.pdf

Australian Strategic Policy Institute: Critical Technologies Tracker, March 2023. https://ad-aspi.s3.ap-southeast-2.amazonaws.com/2023-03/ASPIs%20Critical%20Technology%20Tracker_0.pdf?

AI Impacts: 2022 Expert Survey on Progress in AI (ESPAI 2022). <https://aiimpacts.org/2022-expert-survey-on-progress-in-ai/>



5.1
Value of
Innovation



5.2
Frontier
Technologies



5.3
Humans &
Machines



Megatrend 6

Health & Care



Beyond pandemics: Together, policy makers and health experts must find solutions for myriad health and caregiving challenges

Subtrends of megatrend "Health & Care"

1



Global Health Challenges

2



Healthcare of the Future

3



Caregiving

While COVID-19 no longer constitutes an international public health emergency, other urgent global health challenges remain for the future

13 most urgent global health challenges for the decade ahead according to the WHO



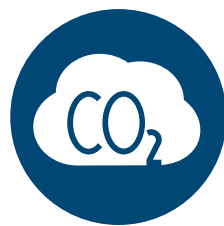
Health challenges extend to a broad range of topics and reflect medical as well as ecological, technological, political and social challenges

Selected global health challenges



Preparing for epidemics

- > The COVID-19 crisis has reinforced the message that it is **not a matter of 'if'** another epidemic will strike, **but 'when'**
- > Governments **need to prepare** for further outbreaks



Elevating health in the climate debate

- > Air pollution **kills approx. 7 million** people every year
- > Climate change causes more extreme weather events **exacerbating malnutrition** and the **spread of infectious diseases**



Harnessing new technologies

- > Genome editing, synthetic biology, and **digital health technologies** such as artificial intelligence help to prevent, diagnose, and treat diseases
- > Their use should be **encouraged** yet carefully **monitored**



Delivering health in conflict and crisis

- > In recent years, many **outbreaks of dangerous diseases** occurred in countries undergoing **protracted conflicts**
- > In addition, conflicts result in **record numbers of people becoming displaced**, hindering access to healthcare



Making health care fairer

- > People in **wealthier** countries live – on average – 18 years longer than people in **poorer** countries
- > It is paramount to **improve access to primary care** to address patients' health needs

6 Health & Care

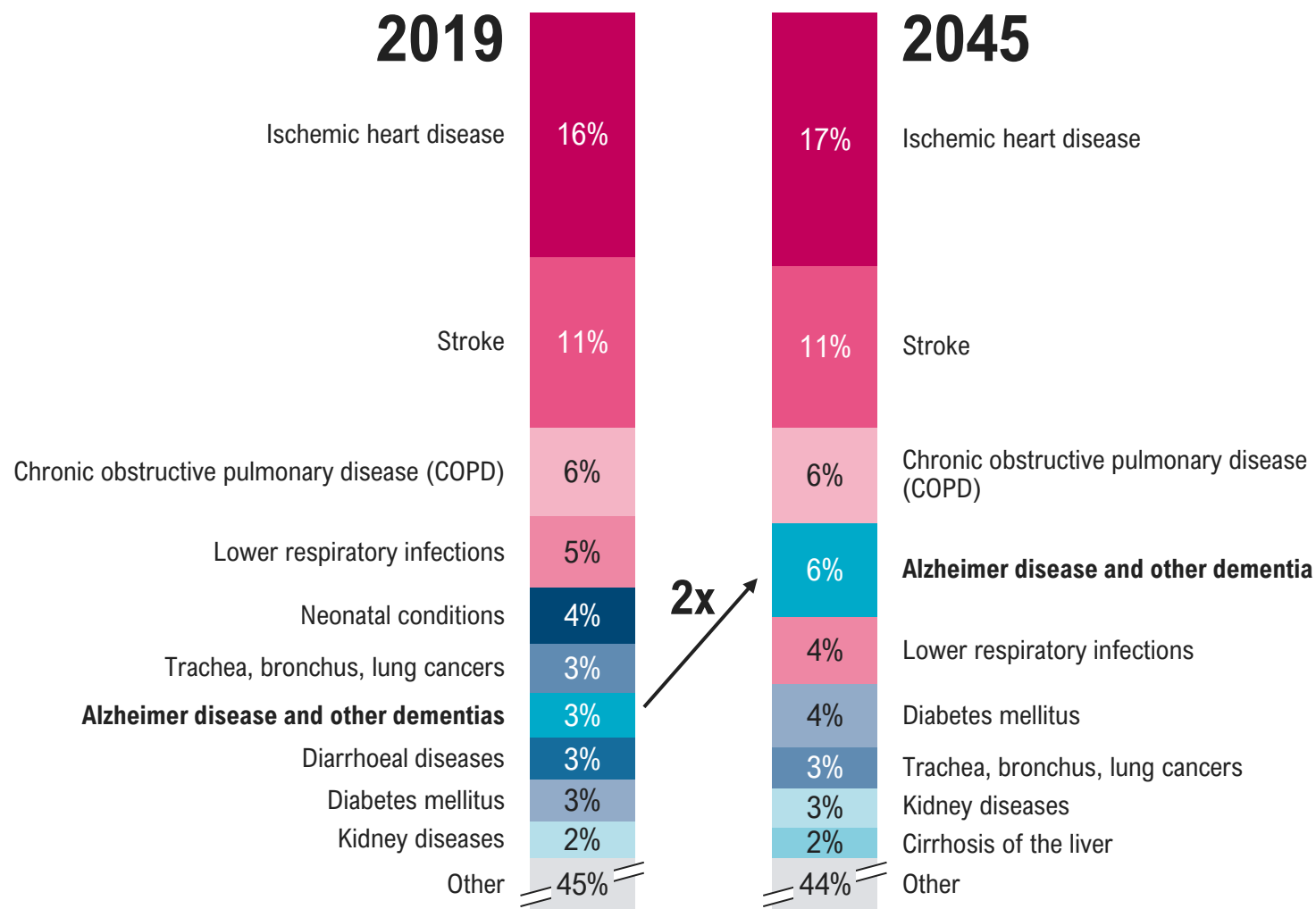
6.1
Global Health Challenges

6.2
Healthcare of the Future

6.3
Caregiving

Globally, 10 diseases cause more than half of all deaths – Lifestyle and age-related diseases, such as dementia, see strongest increases

The 10 leading causes of death, world, 2019 and 2045 [% of all deaths]

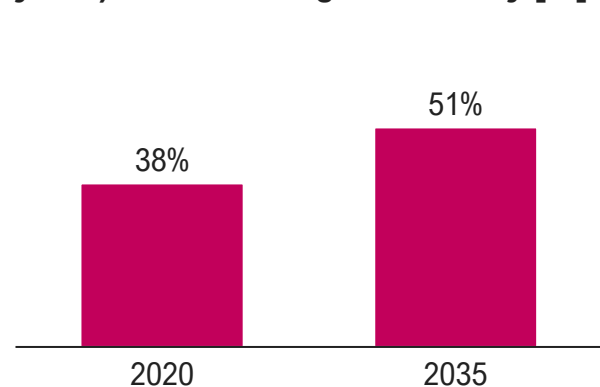


- > In 2019 the **10 leading causes of death** have been responsible for **55% of all deaths globally**. By **2045**, this number is expected to increase slightly
- > **Diseases related to lifestyle and age**, such as ischemic heart disease, COPD, Alzheimer's or diabetes constitute the most frequent causes of death
- > Due to demographic trends such as the **aging of society**, the widespread **improvement of living conditions** in many emerging countries, and an ongoing **shift in lifestyles** (more carnivorous, more sedentary, etc.) the **dominance of such diseases is growing**
- > Notably, the **prevalence of Alzheimer and dementia** as a cause of death **will double until 2045**, as population aging is a significant contributor to shifts in mortality patterns, and it is expected to account for **6% of all deaths globally by 2045**

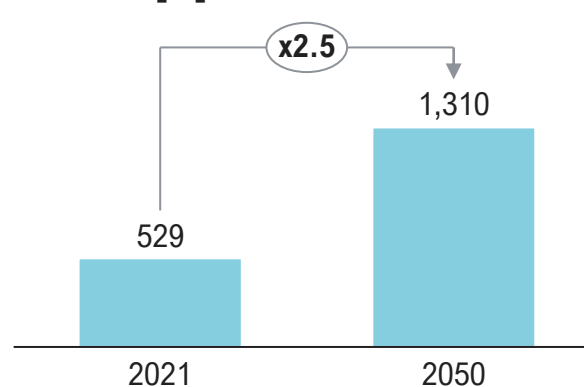
Widespread diseases such as obesity are on the rise – Mental health disorders represent a further burden for people and society worldwide

Key data regarding obesity, diabetes, and mental health disorders

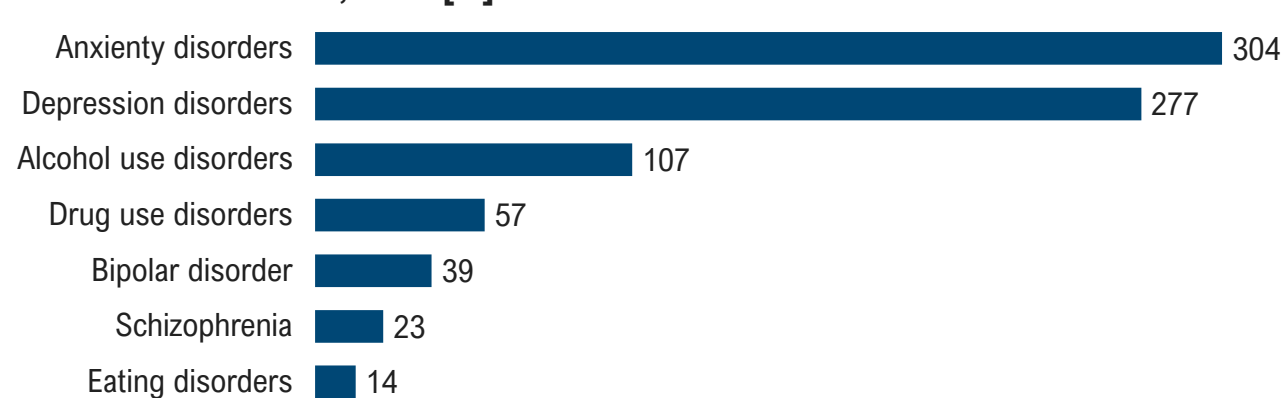
Share of global population (aged over 5 years) with overweight or obesity [%]



Global number of people living with diabetes [m]



Global number of people living with important mental health disorders or drug or alcohol use disorders, 2019 [m]

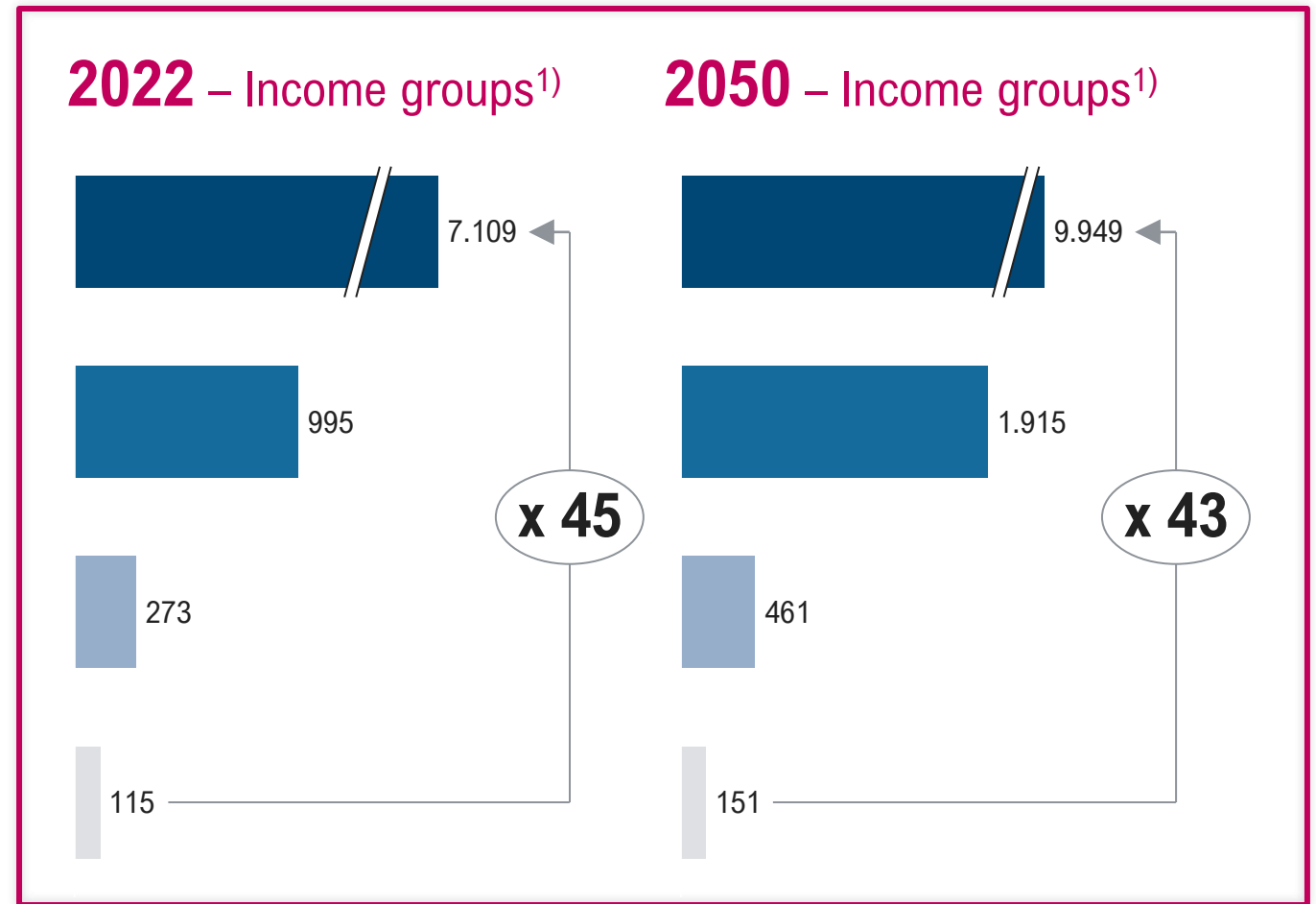
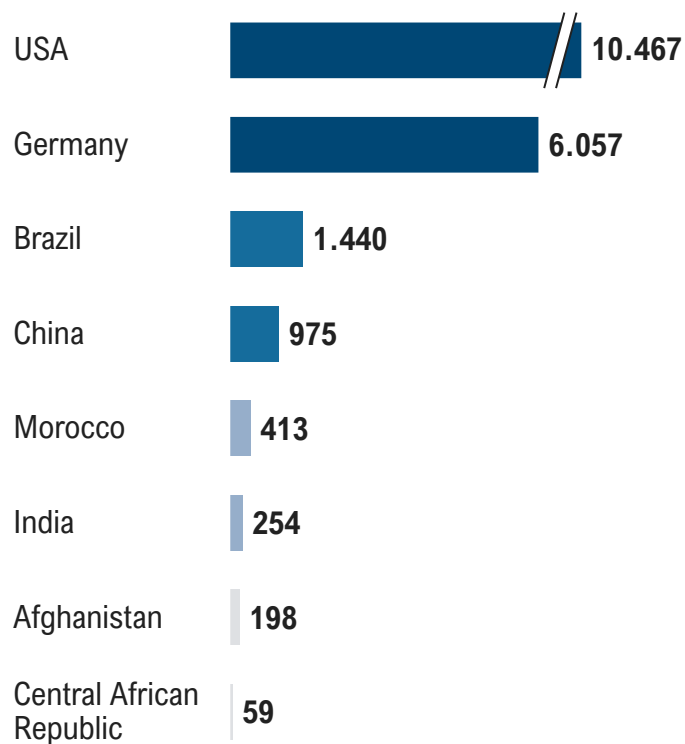


- > People with a BMI of more than 25 are defined as overweight or obese by the WHO. **By 2035, 51 % of the world's population** is expected to be **overweight or obese** – an increase of 13 percentage points within 15 years
- > As a result of rapidly rising obesity rates, **the global diabetes burden** (primarily driven by type 2 diabetes) **will more than double until 2050**, with the age-standardized diabetes prevalence set to exceed 10% in 89 out of 204 countries by 2050
- > It is expected that overweight and obesity will **cost the global economy more than USD 4 trillion** of potential income **in 2035**, nearly 3% of current global gross domestic product
- > **Mental health disorders** such as anxiety depression, bipolar disorders, schizophrenia, and eating disorders as well as substance disorders (drugs, alcohol) are a **high burden for many people worldwide**
- > Over the past three decades, the global share of people affected by mental health disorders has been more or less stable. But **high population growth has led to a strong increase of the total numbers**: by **2019**, there have been **95 million more people with anxiety disorders compared to 1990** and over **87 million more people with depression disorders** compared to the same period

To manage the challenges ahead, future health care spending is set to increase but the gap between high- and low-income countries persists

Expected health spending per capita [USD, PPP]

2022 – Selected countries



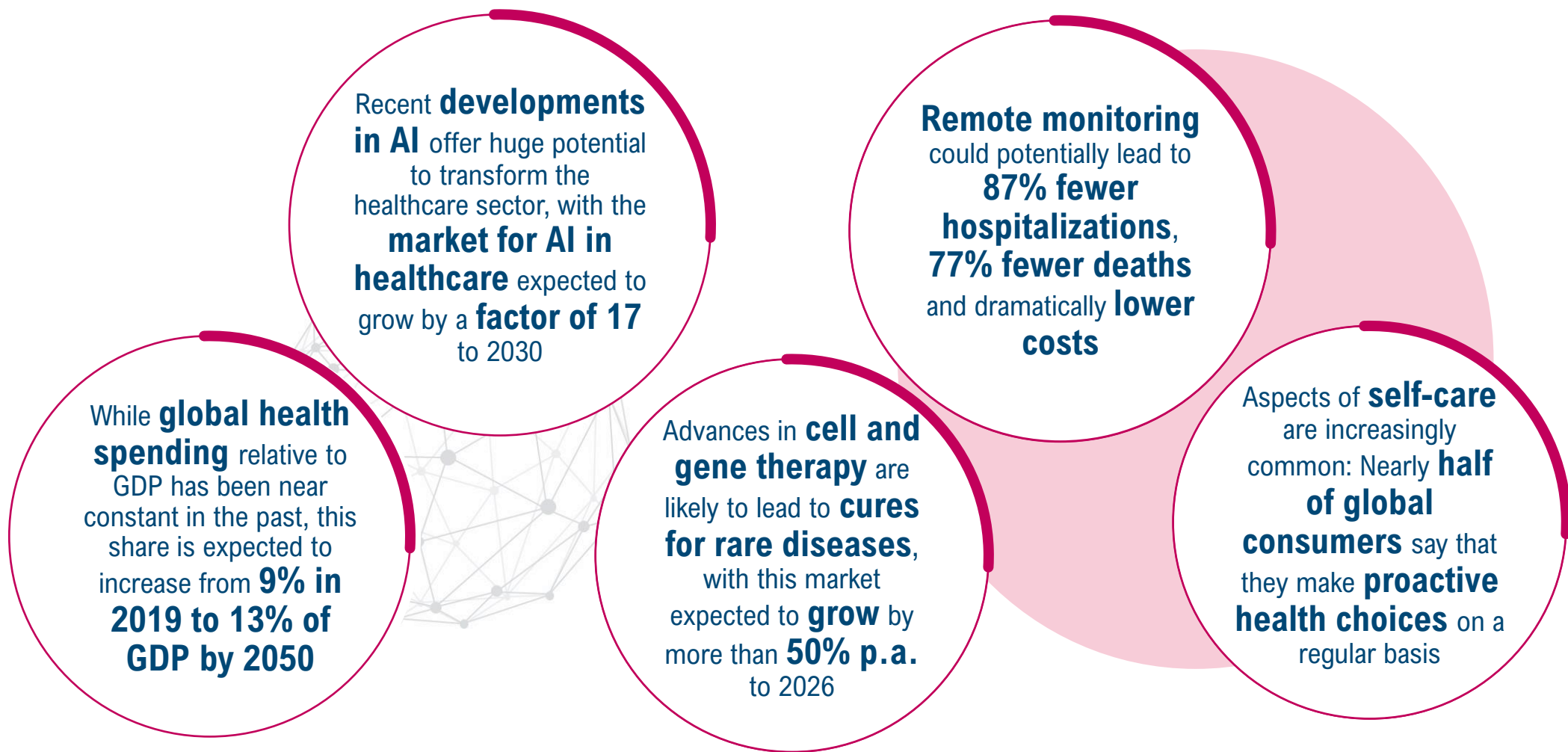
Low income
 Lower-middle income
 Upper-middle income
 High income

1) Population-weighted averages

Sources: Global Burden of Disease Health Financing Collaborator Network; Roland Berger

The healthcare of the future is determined by a variety of trends holding great potential for patients, healthcare companies and employees

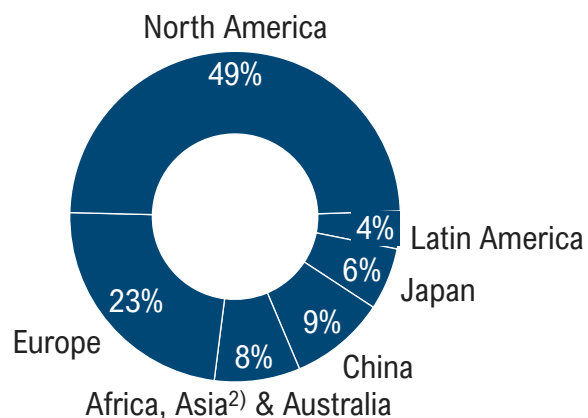
Selection of global healthcare trends



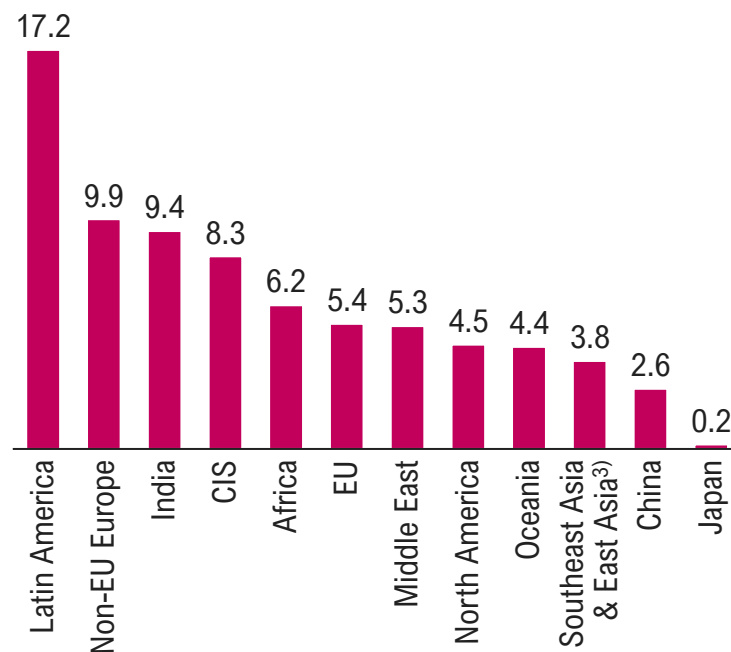
Effective pharmaceuticals are an essential part of modern and future healthcare – Developing countries are catching up rapidly

Overview of the global pharmaceutical market and future developments

Share of pharmaceutical market revenues by region/countries, 2021¹⁾ [%]



Projected annual growth rates of pharmaceutical markets by region/countries, 2020-2026¹⁾ [%]



Global market volume 2021: USD 1,257 billion

Global market volume 2026: USD 2,025 billion

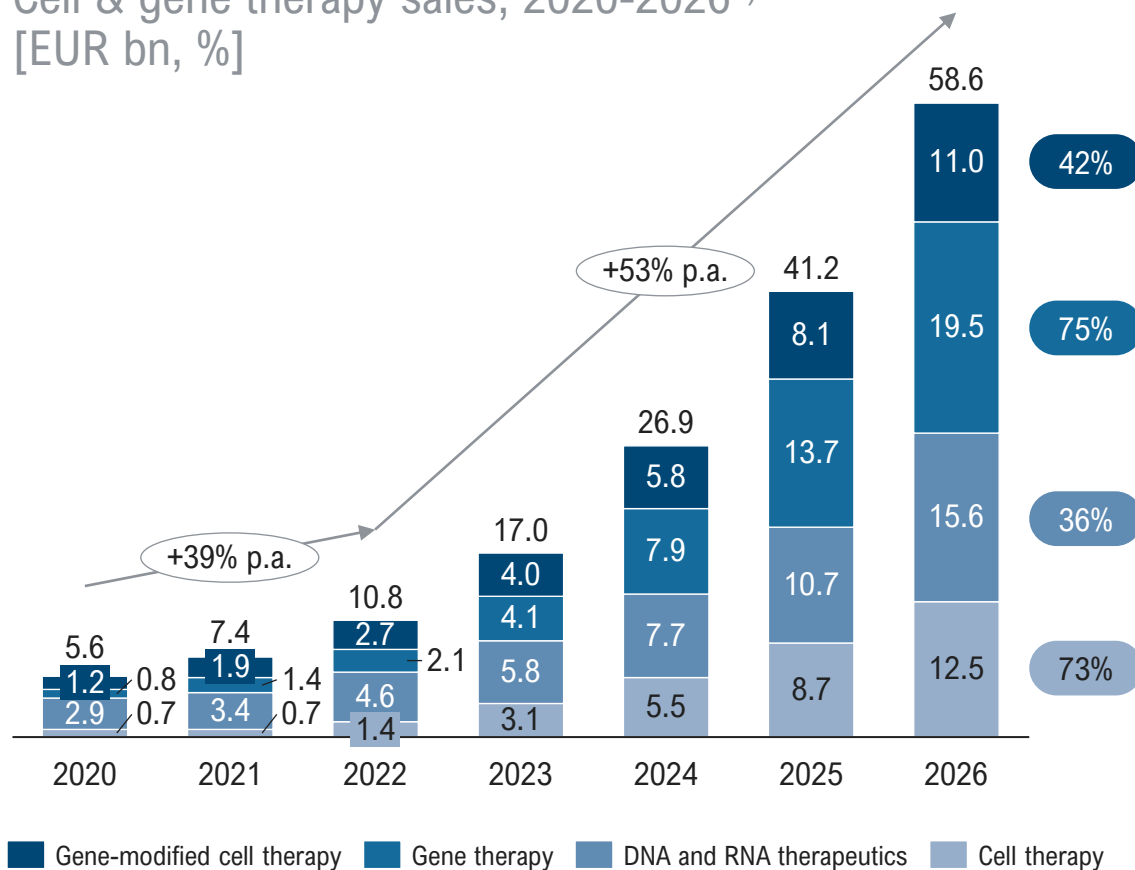
- > **Pharmaceuticals** are an indispensable part of many therapies to **fight diseases**
- > People in **developed economies are best supplied** in terms of pharmaceuticals: In 2021, the **US, Europe and Japan** accounted for nearly **80% of the global market** for prescription-only pharmaceuticals. Another reason for the big share of developed countries is that pharma companies charge **significantly higher prices** in high income markets than in other markets
- > But **emerging and developing countries are expected to catch up**: Latin America, India and Africa are among the regions and countries with the highest growth rates in future years
- > In addition to **government efforts** and/or **foreign development aid**, **big philanthropic organizations** (such as the Bill and Melinda Gates Foundation) are also helping to facilitate improved access to pharmaceuticals in developing countries
- > **New classes of pharmaceuticals** give rise to further **optimism** regarding improved treatment of a **range of diseases**: For example, intense research efforts are underway to develop **mRNA vaccines** – a gamechanger in the fight against COVID-19 – to fight **malaria** or certain types of **cancer**

1) Prescription-only pharmaceuticals; 2) Excl. China and Japan; 3) Excl. China, India and Japan
Sources: EFPIA; AstraZeneca; Roland Berger

Cell and gene therapies exemplify highly promising innovations enabling restoration of biological function and treatment of as yet incurable diseases

Cell and gene therapies are currently the subject of **intense research and investment** by many pharmaceutical companies. The aim is to deliver **cures for rare diseases** and to enable **new therapeutic approaches** for more widespread diseases, e.g. oncology or heart failure. Such therapies work **by employing engineered cells as therapeutics** or by **replacing defective or missing genes** in a patient's cells

Cell & gene therapy sales, 2020-2026¹⁾
[EUR bn, %]



Cell & gene therapy opportunities



Enables **treatment of previously incurable diseases**



Precision medicine and ability for **individualized customization**



Long lasting effect, requiring mostly one-off treatments



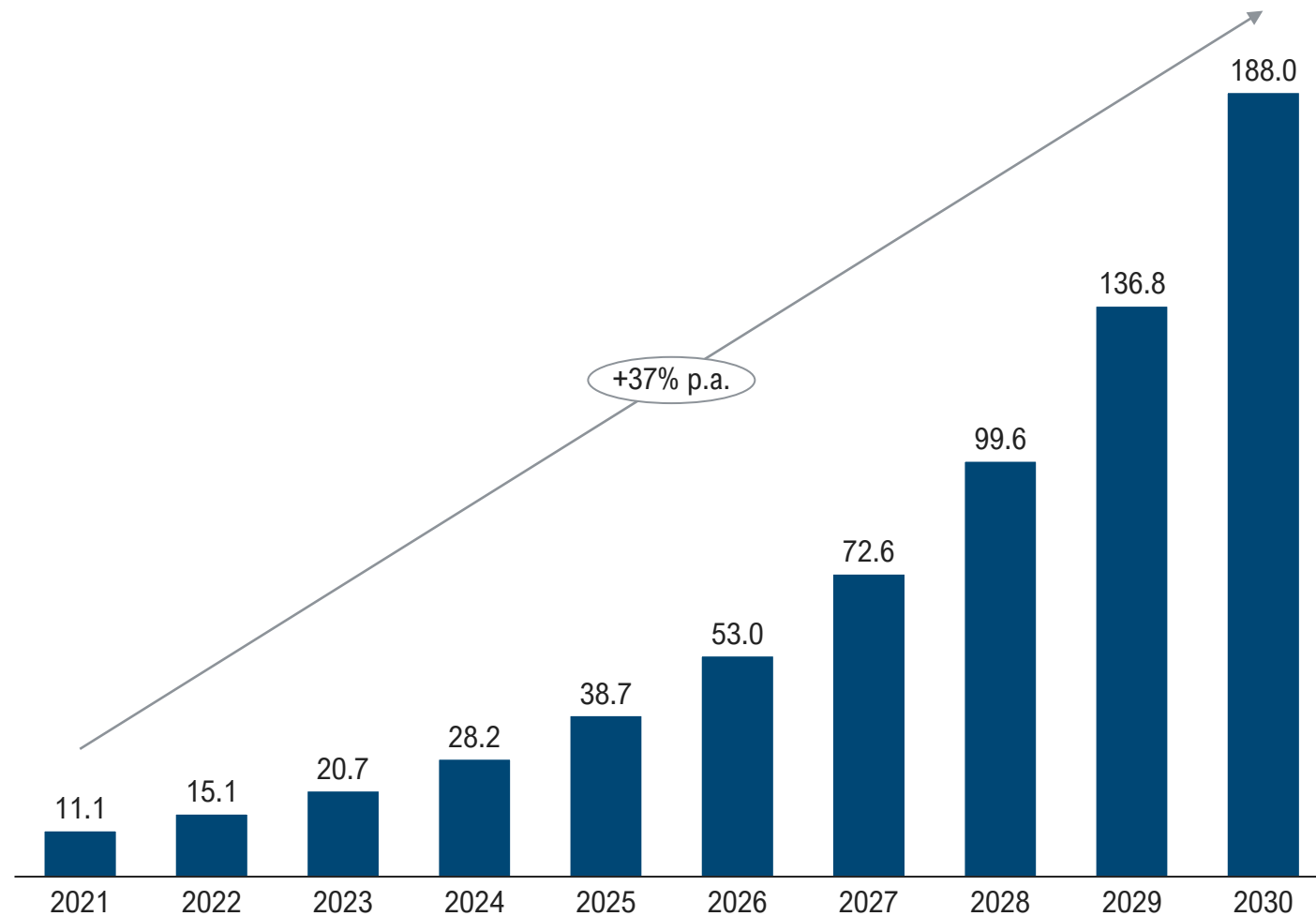
In the future, possibility of **novel curative mechanisms** through further cell enhancements, e.g. via local payload (such as cytokines) secretion

1) Including combination Advanced Therapies and Medicinal Products (ATMPs)

Sources: EvaluatePharma; Roland Berger

Artificial intelligence capabilities are increasingly entering the healthcare sector, signaling faster, life-saving diagnoses as well as cost reductions

Global market of artificial intelligence in healthcare, 2021-2030 [USD bn]

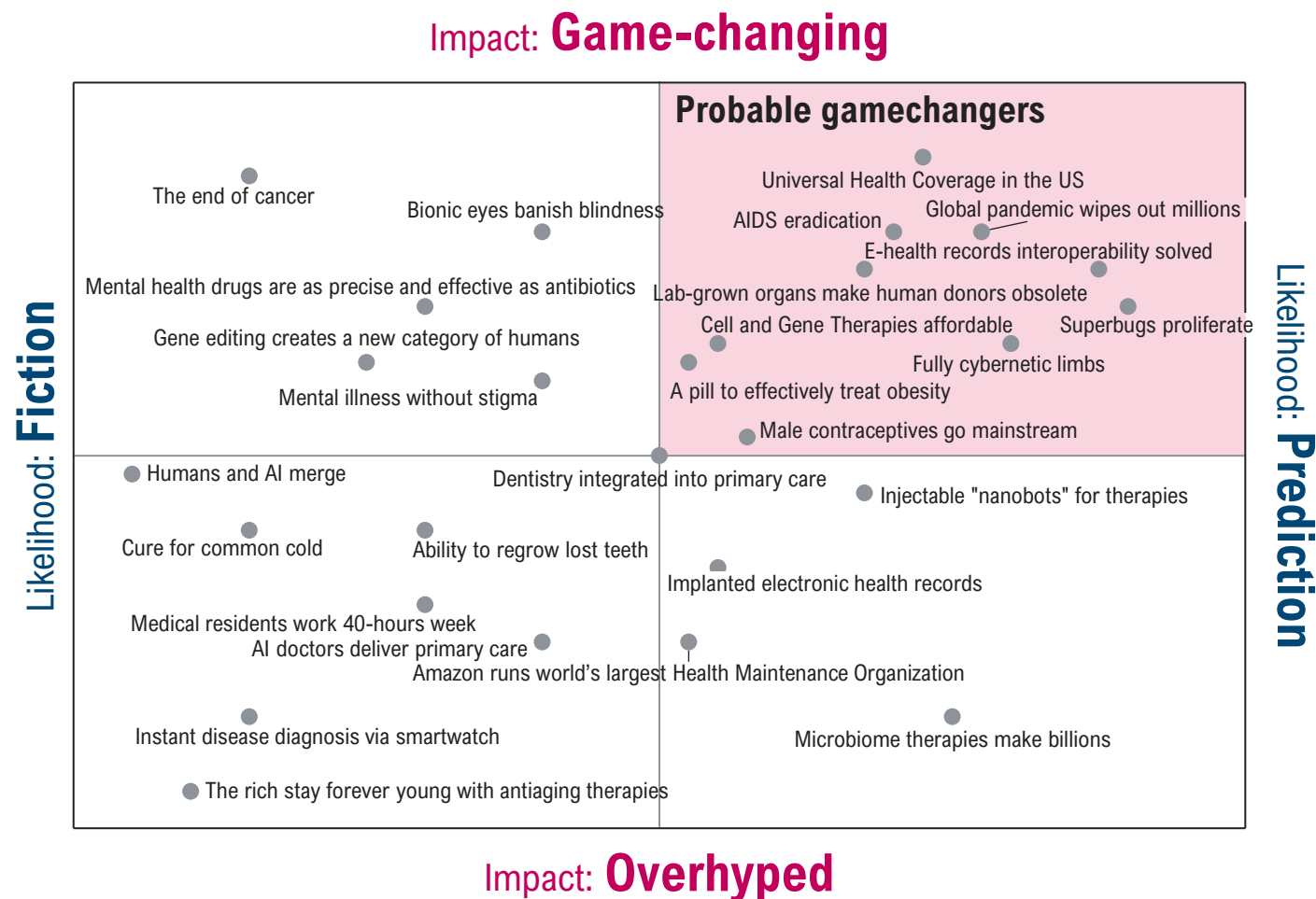


- > With an average growth rate of 37% p.a. from 2021 to 2030, the **global market for AI in healthcare** is set to **boom**, reaching a total value of USD 188 billion in 2030
- > Key reasons for this explosive growth trajectory are the **increased capabilities and performance of AI**, the large volume of **digitalized health data**, **personalization of medical care**, and the **growing prevalence of chronic diseases** in an aging society requiring more efficient healthcare systems
- > Specific use-cases include the delivery of **faster and more accurate diagnoses**, whereby AI analyzes vast data pools of disease patterns, lowering the error rate (compared to medical professionals), resulting in potentially life-saving advantages in terms of decision, waiting and recovery time
- > Another use-case is the **automatization of administrative tasks**, where AI can schedule appointments, sort patient records, or process insurance claims. This allows medical staff to focus their time on delivering patient care – instead of handling administrative ‘red tape’

1) Including combination Advanced Therapies and Medicinal Products (ATMPs)
Sources: Precedence Research; Roland Berger

Between fiction and prediction: Advances in healthcare are subject to many expectations – Not all are likely to materialize by 2050

Likelihood and impact of selected health predictions toward 2050 according to a 2020 survey of UCSF¹⁾

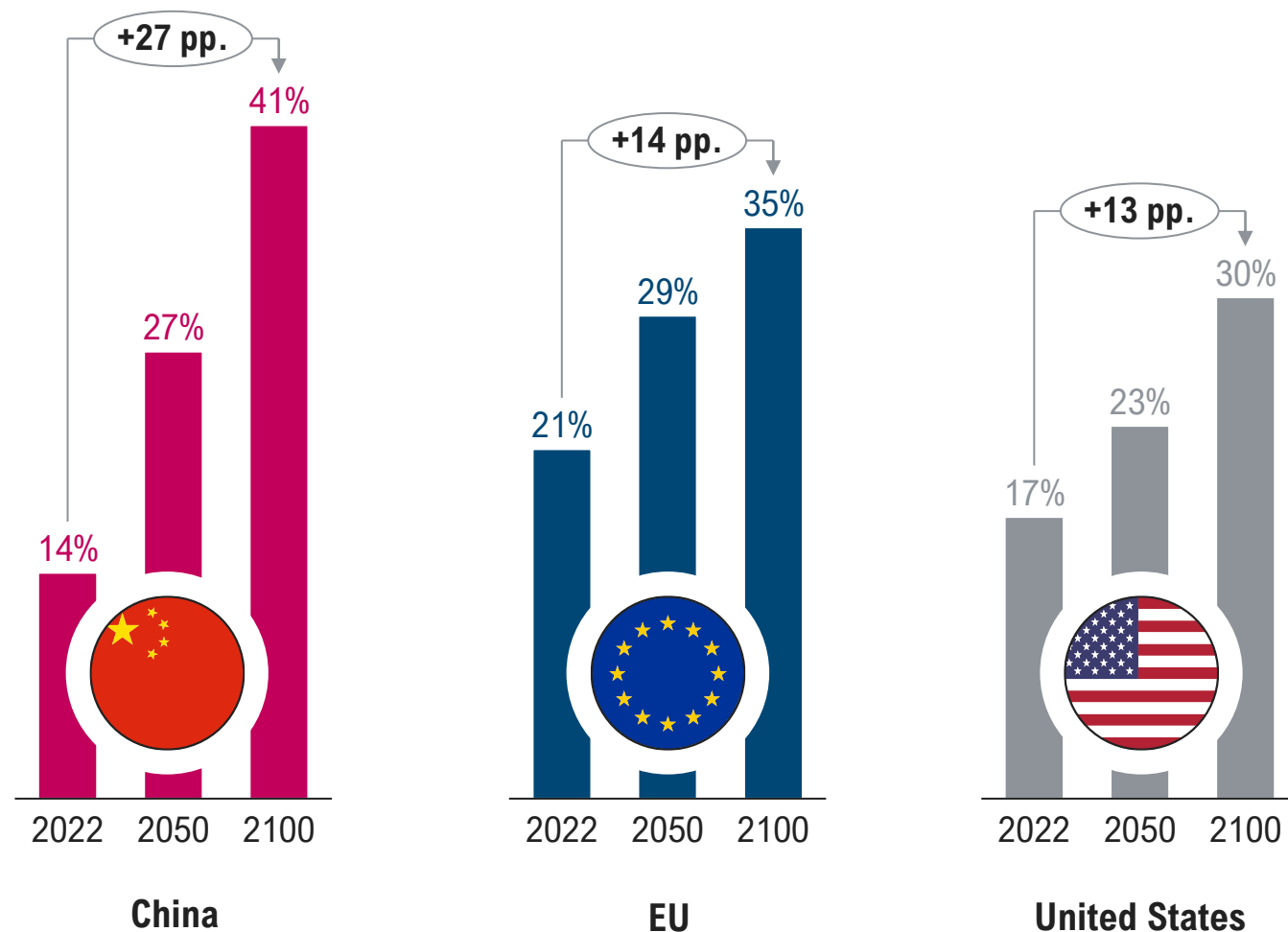


- > Healthcare is one of the sectors with the **highest levels of investment** in new technologies, new treatment options, and new drugs
- > High levels of investment increase the **probability** for innovations to succeed, but many promising ideas still fail further down the line: **Predicting** future feasibility or game-changers is highly difficult and **uncertain**
- > The **University of California San Francisco (UCSF)**, a leading university in health science, tried to **evaluate selected future health predictions**
- > The UCSF survey distinguishes between the **impact** of a healthcare outcome (on a scale ranging from Overhyped to Game-changing) as well as the **probability** of the outcome coming into effect (on a scale from Fiction to Prediction)

1) In 2020, University of California San Francisco (UCSF) faculty and alumni scored the above predictions for likelihood and impact. In the matrix we show all predictions except for two that are specific to the US
Sources: UCSF; Roland Berger

Caregiving is a key part of health and care systems: Elderly people require the largest share of caregiving, and this will increase in aging societies

People aged 65+ as a share of total population [%]



- > **Demand for caregiving** is directly related to the **aging of societies** as the **need for care increases strongly after the age of 65**
- > **Population aging is particularly prominent in China**, where the one-child policy and greater prosperity have significantly subdued birth rates, while advances in health care have prolonged life expectancy. In **China**, for the first time since 1961, **deaths have outnumbered births in 2022** – demarking a turning point in China’s demographics
- > Many **other parts of the world** – like the EU and the US – are **facing comparable challenges** as populations are growing older. Faced with a larger shares of the over 65s, health and social care systems will encounter **significant challenges and ever greater demand for care**
- > Moreover, global population aging will impact nearly all aspects of our life; shifts in disease burden, labor shortages, increased health expenditure, and economic repercussions are all likely to **reshuffle life as we know it**

A rising number of professional caregivers is required to support the growing number of older people

Estimated demand for long-term care (LTC) workers for OECD 32 countries¹⁾

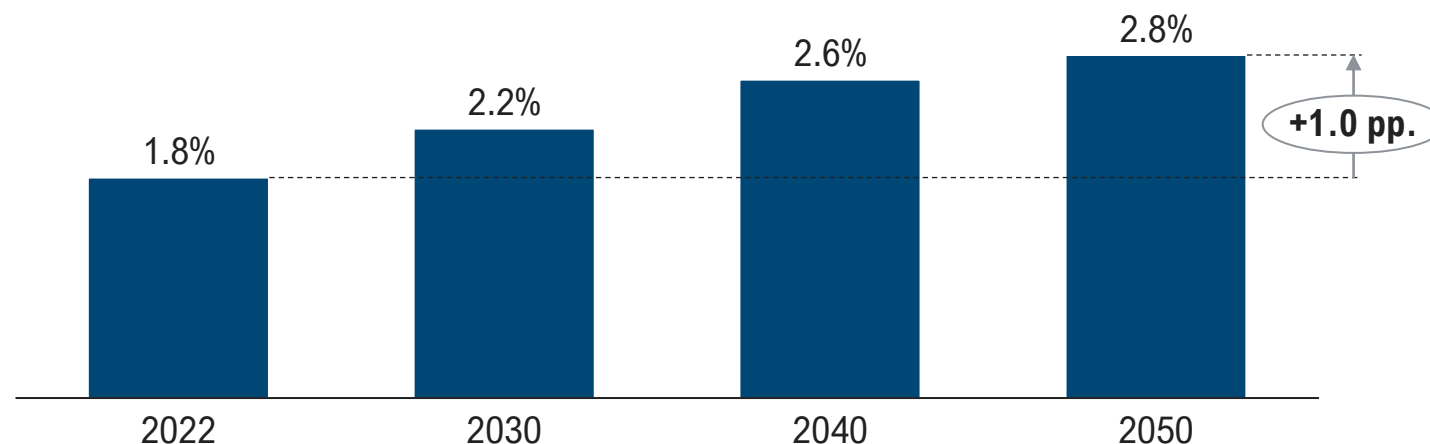
Old age dependency ratio, 2022 and 2050²⁾



LTC workers per 100 people aged 65+, 2019



Share of working-age population employed in LTC jobs, 2022-2050 [%]



- > The demand for care workers is expected to increase in the coming years due to several **demographic and social factors**
- > The **population** in many OECD countries is **aging**, i.e. there will be an increasing number of elderly people requiring care services. As of 2022, **there are about 35 elderly per 100 capita in working age**. By 2050, it is expected that this ratio increases to **53 elderly per 100 capita in working age**
- > In addition, there is a trend towards **people with disabilities living longer** and more independently. This will require more ongoing support and assistance
- > As of today, about **1.8%** of the workforce in OECD countries work in long-term care (LTC) jobs. This translates into **5.2 LTC workers per 100 elderly**. If this rate is to be maintained, about **2.8% of the OECD working-age population** would have to work in LTC jobs in 2050, given the rise in population aged 65+ in case there are no productivity increases

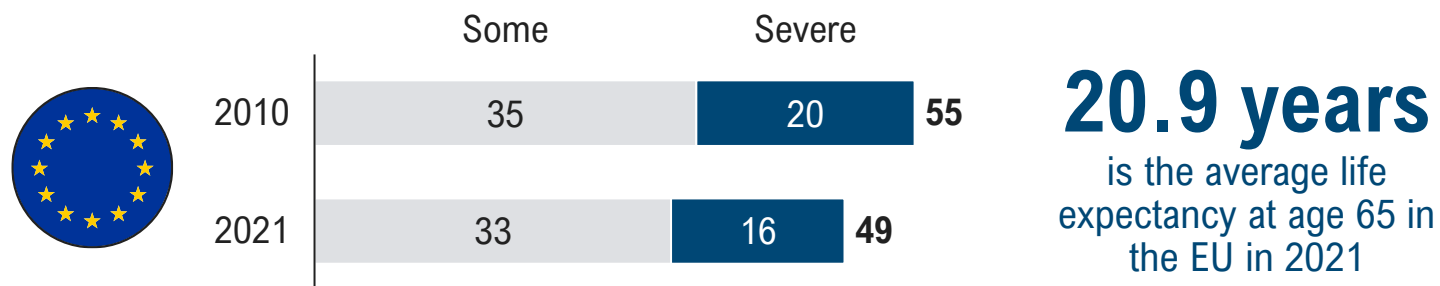
1) The OECD countries covered by this analysis are Australia, Austria, Belgium, Canada, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Republic of Korea, Slovakia, Slovenia, Spain, Sweden, Switzerland, United States

2) The old age dependency ratio is calculated by dividing the amount of people aged 65+ by the amount of people in the working age (20-64) group

Sources: OECD; UN; Roland Berger

Around half of Europe's elderly have long-term limitations due to health issues – Retirement income is largely insufficient to cover LTC costs

EU inhabitants aged 65+ with self-perceived long-term limitations due to health problems [%]



- > Long-term care (LTC) spending refers to expenses for **providing health and social services** to individuals who require ongoing care due to their LTC dependency. This includes palliative care and care given in LTC institutions or at home, including room and board costs
- > **Public schemes** play a **critical role** in ensuring that the cost of care for older adults with LTC needs are maintained at affordable levels. Without public financial support, the total of **LTC expenses would surpass the median incomes** of older people in most EU member states
- > In 2020, the total cost of care was **highest in Finland and Sweden**, compared to median incomes among older individuals
- > Conversely, **costs were lowest in Croatia and Slovenia** (where data was available). **Only in these two countries** would an older person with **median income** be **able to afford** the total cost of institutional long-term care from their income alone

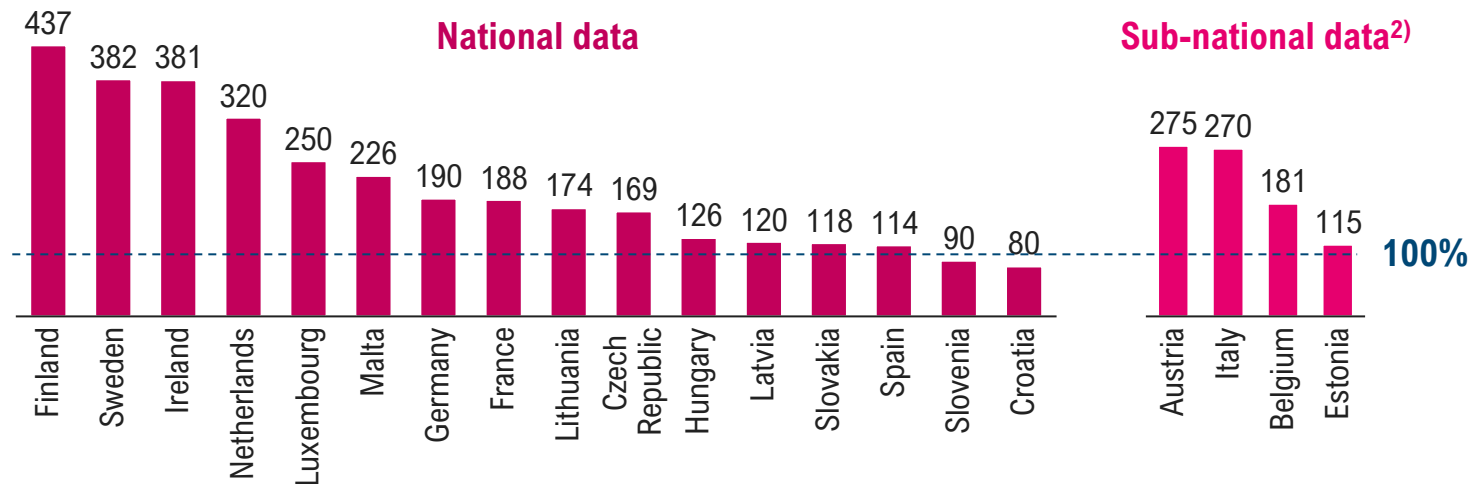
6 Health & Care

6.1 Global Health Challenges

6.2 Healthcare of the Future

6.3 Caregiving

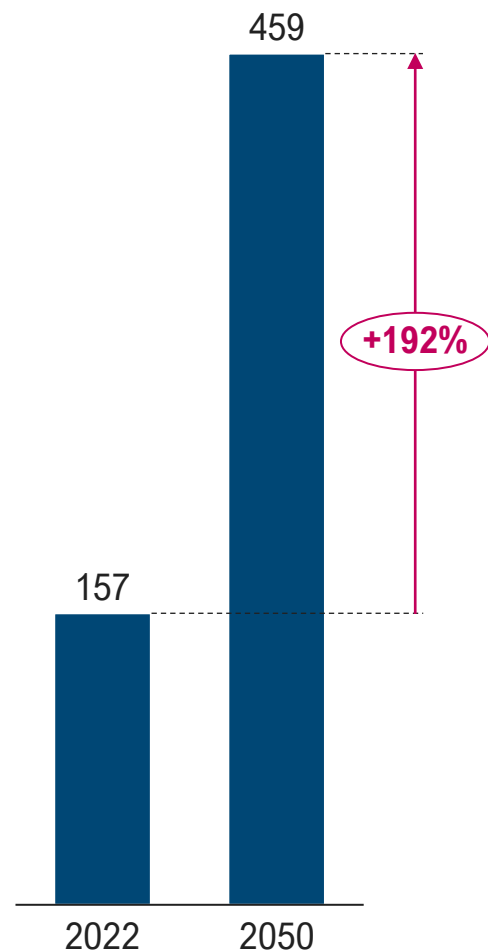
Costs of institutional long-term care for an older person with severe needs, as a share of the median income among people of retirement age and older, 2020¹⁾ [%]



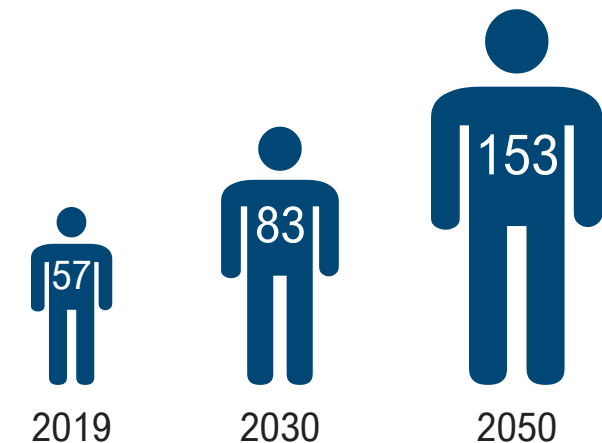
1) Or nearest year available 2) Austria refers to Vienna, Italy refers to South Tyrol, Belgium refers to Flanders, Estonia refers to Tallinn
Sources: Eurostat; OECD; Roland Berger

The rise of age-related diseases – such as dementia – also signals a rapidly growing need for cost-intensive care

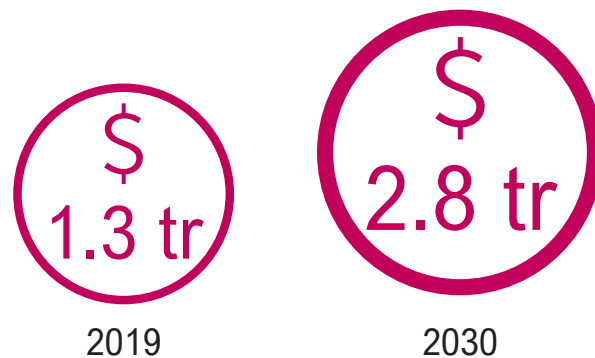
Global population aged 80+ years, 2022 and 2050 [m]



Global number of people living with dementia, 2019-2050 [m]



Worldwide cost of dementia, 2019 and 2030 [USD tr]



- > With more and more people getting older, age-related diseases are on the rise. A prominent example of such an **age-related and care-intensive disease** is **dementia**
- > Rates of dementia **rise sharply with age**. In the US in 2019, about 3% of people aged 70-74 years had dementia, compared with **22% aged 85-89 years and 33% aged 90 and older**
- > Globally, the number of people aged 80 years or older will **nearly triple** from 2022 to **2050 to 459 million**
- > **Early clinical symptoms** of dementia comprise the **difficulty of recalling conversations**, names or events as well as apathy and depression. **Later symptoms** include impaired communication, **disorientation and confusion**, behavioral changes and, **ultimately, difficulty speaking, swallowing, and walking**
- > Dementia has a physical, psychological, social, and economic **impact on patients but also on their care systems**, including doctors, caregivers, families and friends, and society at large
- > Currently around **57 million people are living with dementia globally**. This number is expected to nearly **triple to 152 million by 2050**
- > The current decade is expected to 'only' see an increase of around 25 million people; this will already cause the **global cost of dementia** of currently USD 1.3 trillion to **more than double to USD 2.8 trillion in 2030**

Main sources

Megatrend 6 – Health & Care

World Health Organization (WHO): Urgent health challenges for the next decade, retrieved May 2023. <https://www.who.int/news-room/photo-story/photo-story-detail/urgent-health-challenges-for-the-next-decade>

WHO: Global Health Estimates 2019. <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates>

Global Health Data Exchange (GHDx): Global expected health spending, 2021. <https://ghdx.healthdata.org/record/ihme-data/global-expected-health-spending-2019-2050>

European Federation of Pharmaceutical Industries and Associations (EFPIA): The pharma industry in figures, 2022. <https://www.efpia.eu/media/637143/the-pharmaceutical-industry-in-figures-2022.pdf>

Precedence Research: Artificial intelligence in the healthcare market, 2023. <https://www.precedenceresearch.com/artificial-intelligence-in-healthcare-market>

University of California San Francisco: What Will Health and Medicine Look Like in 2050?, 2020. <https://www.ucsf.edu/magazine/health-2050-predictions>

OECD: Long-Term Care Resources and Utilization, retrieved May 2023. https://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_LTCR

OECD: Long-term care workforce: caring for the ageing population with dignity, retrieved May 2023: <https://www.oecd.org/health/health-systems/long-term-care-workforce.htm>

UN Population Division: World Population Prospects 2022. <https://population.un.org/wpp/Download/Standard/Population/>

6 Health & Care



6.1

Global Health Challenges



6.2

Healthcare of the Future



6.3

Caregiving

Authors



Dr. Christian Krys
Senior Expert
Roland Berger Institute

+49 (211) 4389-2917
christian.krys@rolandberger.com



Dr. David Born
Manager
Roland Berger Institute

+49 (69) 29924-6500
david.born@rolandberger.com




Steffen Geering
Specialist
Roland Berger Institute

+49 (211) 4389-2194
steffen.geering@rolandberger.com

Photo credit

Page 1	vegefox.com/Adobe Stock
Page 4	VTT Studio/Adobe Stock
Page 5	From left to right: Bohanka/Adobe Stock; Offscreen/Adobe Stock; chaoss/Adobe Stock; Brian Jackson/Adobe Stock
Page 17	vacant/Adobe Stock
Page 18	From left to right: Rasi/Adobe Stock; vegefox.com/Adobe Stock; VanderWolf Images/Adobe Stock
Page 27	whitcomberd/Adobe Stock
Page 28	kalafoto/Adobe Stock; Wirestock/Adobe Stock; Lee Prince/Adobe Stock
Page 42	Leonid/Adobe Stock
Page 43	From left to right: ake1150/Adobe Stock; CHW/Adobe Stock; Frank Fennema/Adobe Stock; weyo/Adobe Stock
Page 53	putilov_denis/Adobe Stock
Page 54	From left to right: ipopba/Adobe Stock; ipopba/Adobe Stock; NiK0Stude0/Adobe Stock
Page 67	fizkes/Adobe Stock
Page 68	everythingpossible/Adobe Stock; Damian/Adobe Stock; Ocskay Bence/Adobe Stock
Pages 84/86	vegefox.com/Adobe Stock



[f /Vietnam_Market_Report_Platform](#)

Roland
Berger

