Trend Compendium

2050

Six megatrends
that will shape the world

December 2020

Roland Berger

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

> 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**

Is it worth dealing with megatrends when there are such drastic global events as the Corona pandemic taking place?

Clearly yes! The Corona pandemic has far-reaching consequences and affects us deeply, all within a very short time – but in itself the pandemic does not set aside the megatrends here analyzed. Such is the inherent nature of megatrends: Climate change, the aging of society or the ongoing evolution of technology do not lose their overriding direction or importance. To cope with such challenges – and to master resulting opportunities – our awareness and understanding of these megatrends is paramount in order to develop sustainable answers

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… and covers six megatrends that shape the future development of our world until 2050

1
People & Society

Population

Migration

Values

Education

2
Health & Care

Pandemics & Other Wildcards

Diseases & Treatments

Caregiving

3
Environment & Resources

Climate Change & Pollution

Resources & Raw Materials

Ecosystems at Risk

4
Economics & Business

Globalization Revisited

Power Shifts

Sectoral Transformation

Debt Challenge

5
Technology & Innovation

Value of Technology

Artificial Intelligence

Humans & Machines

6
Politics & Governance

Future of Democracy

Governance & Geopolitics

Global Risks

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Megatrend 1
People & Society

5

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

Subtrends of megatrend "People & Society"

1 Population

2 Migration

3 Values

4 Education

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Population trends toward 2050 point at a myriad of changes across the globe – For continents and countries, their growth rates and age structures

Global population trends – Selected facts & figures

In 2050, **1.9 billion more people** will inhabit our planet (2020: 7.8 billion 2050: 9.7 billion)

World population growth is fueled by growth in less developed countries. **Population in Sub-Saharan Africa will double** from 2020 to 2050

Our world is **aging.** In **2050** there will be more than 1.5 billion people aged 65+ years (2020: 727 million) and **3.2 million aged 100+**

Despite global aging, huge **differences** in the **median age** of countries persist in 2050: **Niger: 19.0 years vs. South Korea: 56.5**

Around 2027, **India** is expected to overtake China as the world's **most populous country.** In 2050 India will have more than 1.6 billion inhabitants

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 71 people per sq km[1] – a quarter of the population density of the United Kingdom today

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

Evolution of world population 1950-2100 [bn]

2100: 10.9 bn

2050: 9.7 bn

2020: 7.8 bn

1950: 2.5 bn

1950   2000   2050   2100
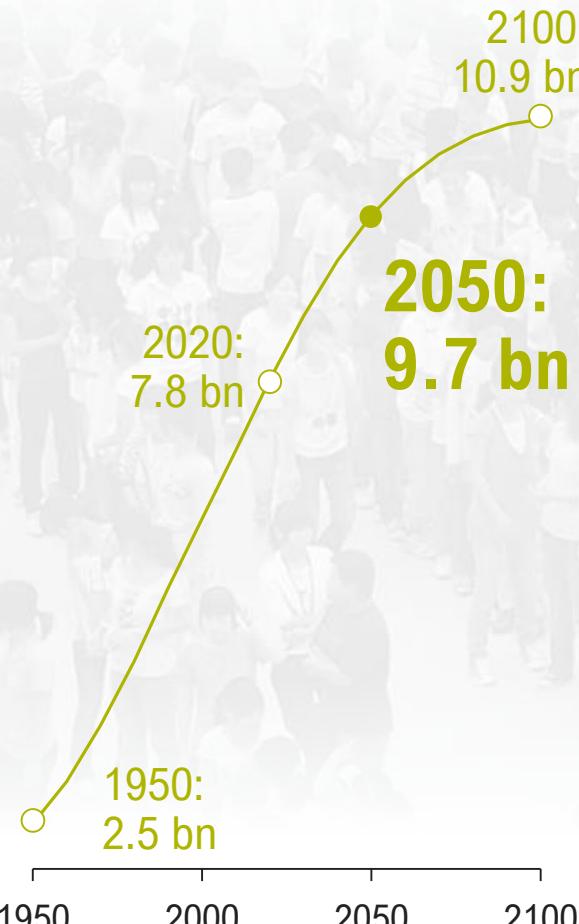
Global population characteristics 2050 [%]

Economic origin of inhabitants
13%
87%
- Less developed regions
- Developed regions

Residential area of inhabitants[1]
32%
68%
- Rural
- Urban
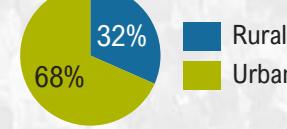
Age of inhabitants
16%
21%
63%
- 0-14
- 15-64
- 65+
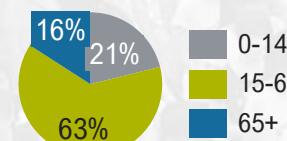
**Life expectancy at birth**
20%
26%
54%
- <70
- 70-80
- >80
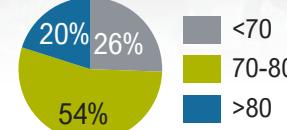
> According to the UN medium variant prediction, the **world population will grow at a slower pace** between 2020 and 2050 compared to previous decades, reaching a population of **9.7 billion in 2050**

> 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 2.5 births per woman in 2020 to 2.2 births per woman in 2050. This lowers the rate of population growth
  – **Average life expectancy** is expected to **increase** from 72.3 years in 2020 to 76.8 years in 2050. 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 70-80 years**

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

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Over the next three decades, Africa's population will increase by more than 1.1 billion – Asia still remains the world's population giant

Population by continent 2020 and 2050 [m]

7,796 (2020)
- Asia: 4,641
- Africa: 1,341
- Europe: 748
- Northern America: 654
- LatAm/Caribbean: 369
- Oceania: 43

9,733 (2050)
- Asia: 5,290
- Africa: 2,489
- LatAm/Caribbean: 762
- Europe: 710
- Northern America: 425
- Oceania: 57

Legend:
- Asia
- Africa
- LatAm/Caribbean
- Europe
- Northern America
- Oceania
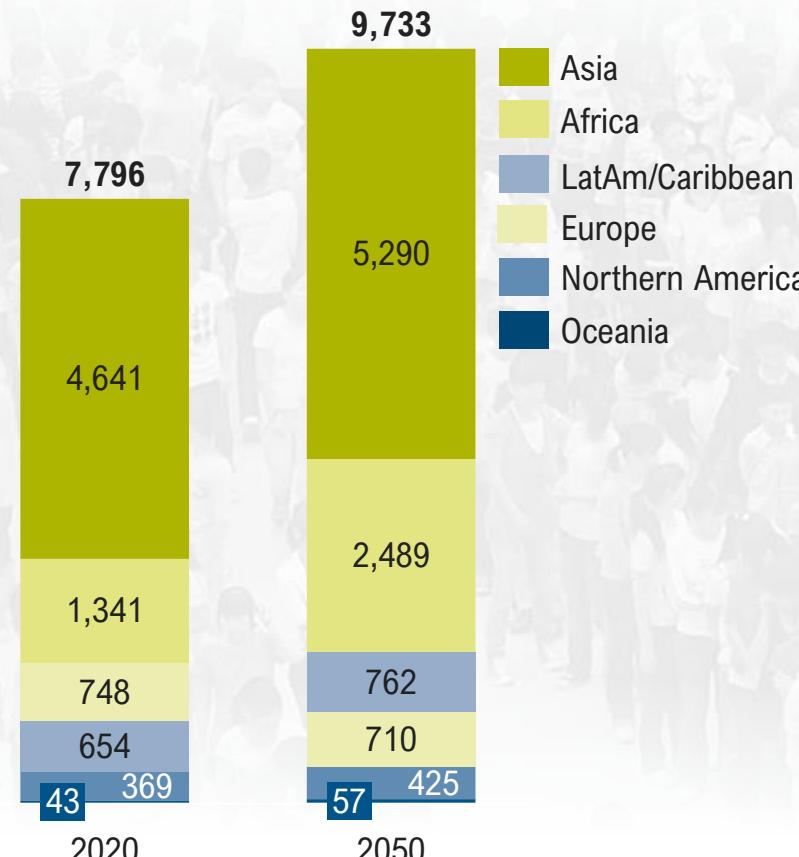
Top five countries per region by population 2050 [m][1]

Region					
Asia	India 1,639	China 1,402	Pakistan 338	Indonesia 331	Bangladesh 193
Africa	Nigeria 401	Ethiopia 205	D.R. Congo 194	Egypt 160	Tanzania 129
LatAm/ Caribbean	Brazil 229	Mexico 155	Colombia 56	Argentina 55	Peru 40
Europe	Russia 136	Germany 80	UK 74	France 68	Italy 54
Northern America	USA 379	Canada 46			
Oceania	Australia 33	Papua N. Guinea 14	New Zealand 6		

1) Only countries with at least 5 million inhabitants are included
Source: UN Population Division

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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
2020 vs. 2050 [people 20-64 / people 65+]
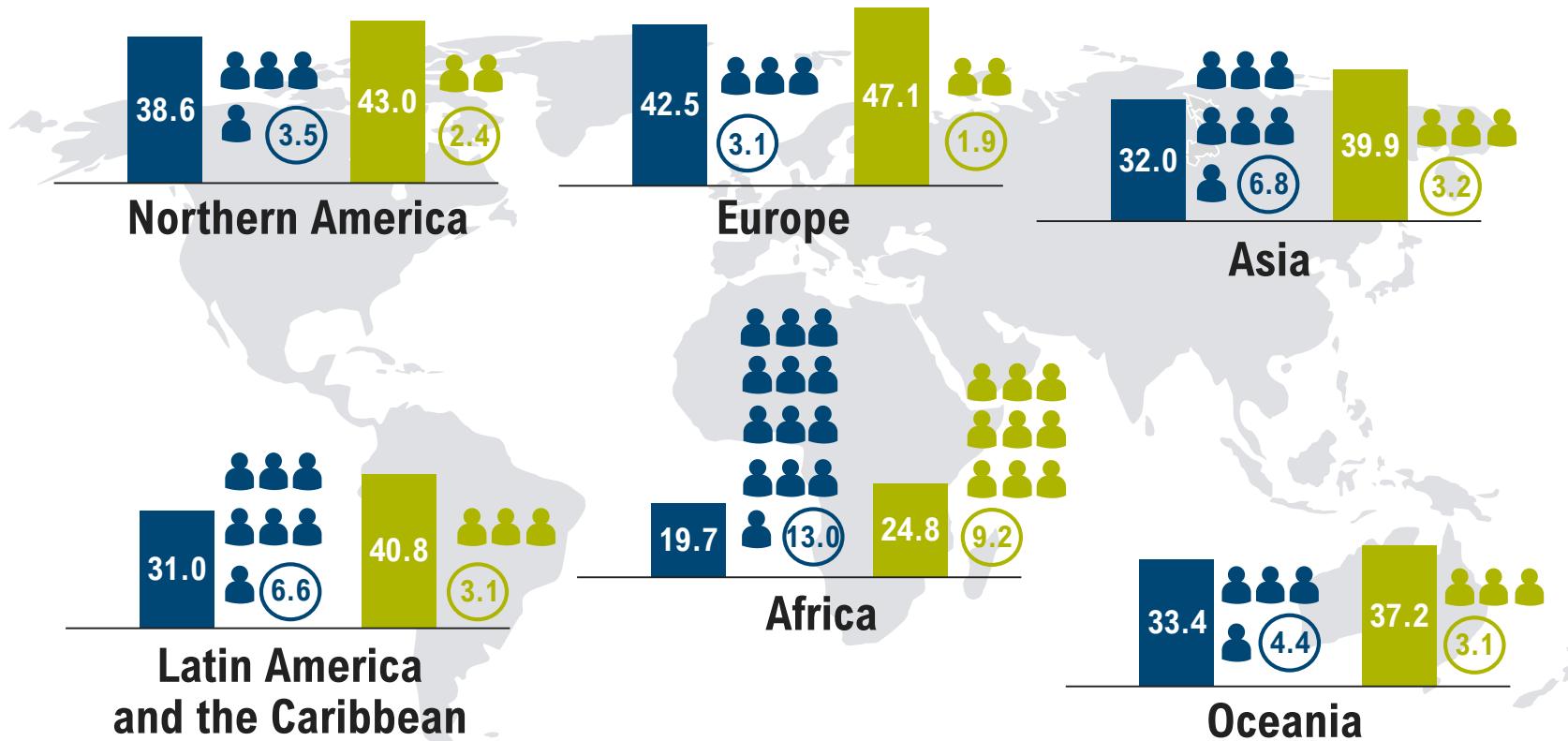
> A **low old-age support ratio** can have **severe consequences** for countries if a large proportion of state expenditure is allocated to e.g. **health and social security**, which is being taken up to a greater extent by older members of society

> However, this ratio ignores that **people above the age of 65 are not necessarily dependent on support** as a rising proportion is in work; reversely not all of those considered of working age are actually working

Median age: ▮ 2020 ▮ 2050   Old-age potential support ratio: ◯ 2020 ◯ 2050

Source: UN Population Division

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 interregional migration flows 2020-2050[1] [m]
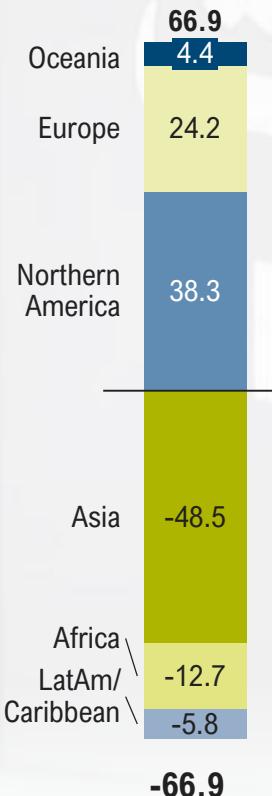
Interregional and intraregional migrants (stock) 2019[2] [m]
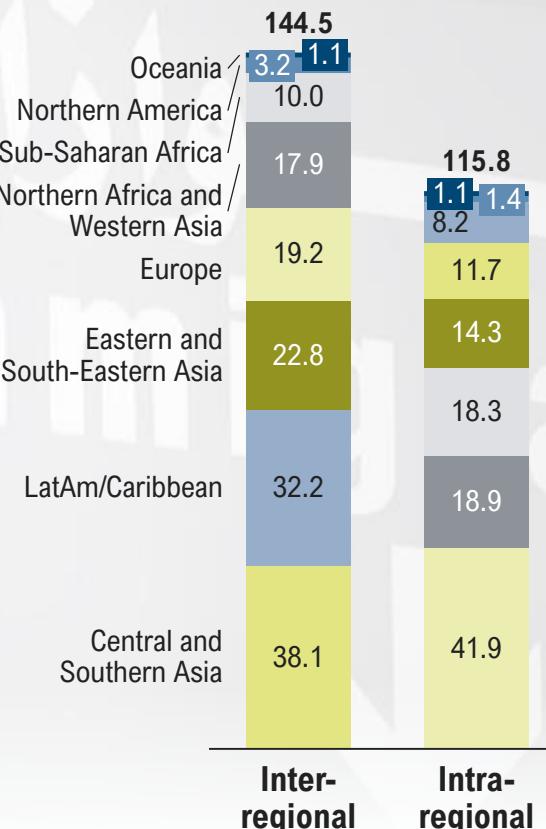
Migrants within countries (IDPs[3] stock) 2019 [m]
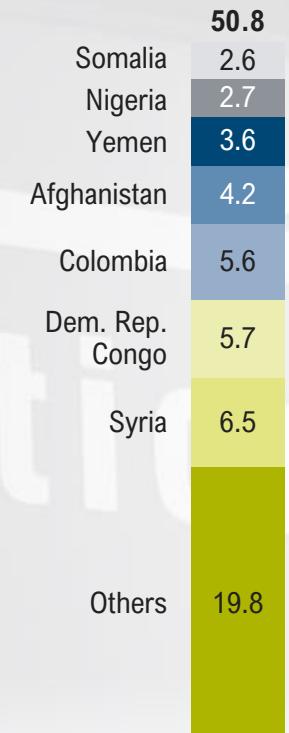
> According to the UN, "**international migrants** are defined as either **living** in a country **other than** their **country of birth** or in a country other than their **country of citizenship**"

> The **majority of international migrants** (total number of interregional/ intraregional migrants 2019: 144.5/ 115.8 million) are **not refugees or asylum seekers** having left their home country due to conflicts, persecution or similar but are defined as migrating for **better economic, educational or other reasons**

> In **2017** there have been **29 million international refugees and asylum seekers** globally. 13.1 million lived in Northern Africa and Western Asia, 5.9 million in Sub-Saharan Africa, 3.6 million each in Europe and Central and Southern Asia, with 2.5 million in other regions

> **IDPs** are **refugees** who stay **within their own country.** 2019, the **majority** of IDPs (45.7 million) **fled conflicts and violence**, the remaining 5.1 million fled disasters

1) Interregional migration includes only migration between regions; data are based on UN medium variant forecast
2) 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

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Without global action to 2050, up to 143 million internal climate migrants are projected for Sub-Saharan Africa, South Asia, and Latin America

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

Sub-Saharan Africa
86 million

South Asia
40 million

Latin America
17 million
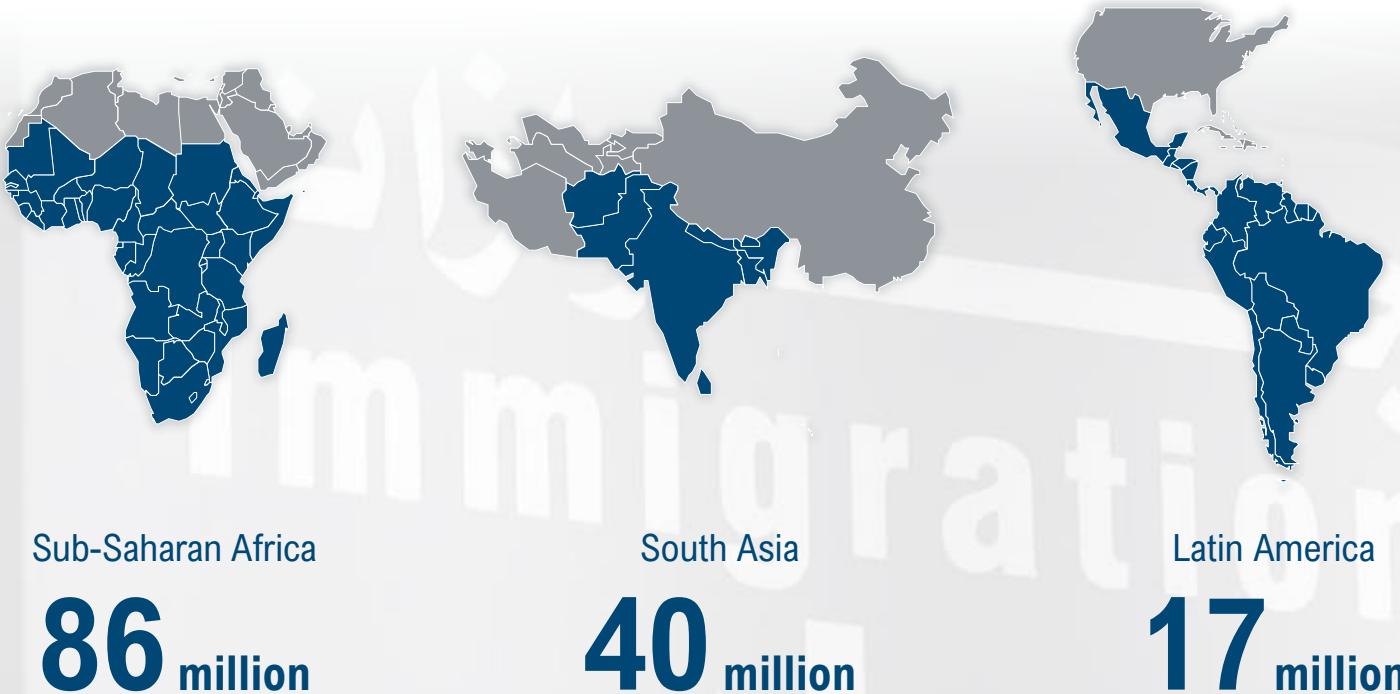
> **Global climate and environmental migration** forecasts to **2050** range widely, from 25 million to 1 billion people

> 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 greenhouse gas emissions combined with unequal development pathways), the World Bank expects **143 million internal climate migrants** in Sub-Saharan Africa, South Asia, and Latin America

> According to World Bank estimates, the **global community** could manage **to lower the number of people forced to move due to climate change by 80%** if we manage to cut greenhouse gases, embed climate migration in development planning, and invest to improve understanding of internal climate migration in the first place

World Bank: "Climate migration is the human face of climate change"

Sources: World Bank; IOM

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According to the UN everyone is entitled to all human rights and freedoms – In reality, achieving these entitlements is mixed and fraught with setbacks

Human rights: Selection of significant developments

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** *(…)"*

Year	Year	Event	Outcome
1990	2020s	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 disrupts an otherwise encouraging downward trend
1991	2017	Aung San Suu Kyi, Myanmar human rights activist and political figure head, is awarded the Nobel Peace prize	More than 740,000 Rohingya Muslim refugees flee to Bangladesh after violent persecution in Myanmar – condoned by Aung San Suu Kyi
2000	2020	Australia allows nonbinary and intersex people to obtain passports with the nonbinary gender marker X	Around the world, at least 15 countries criminalize being transgender
2008	2020	Barack Obama becomes the first black president of the United States	"I can't breathe": George Floyd is brutally killed by police, sparking violent protests and social unrest
2017-2018	2020	King Salman reforms male guardian-ship: Saudi women are allowed to drive and to hold passports	Saudi male guardianship still applies vis-a-vis permission to marry, work, study, prison release or to seek medical care
2018	2019	Greta Thunberg's Fridays for Future: First global climate strike takes place	Donald Trump's administration begins process to withdraw the US from the 2015 Paris climate agreement, taking effect in November 2020
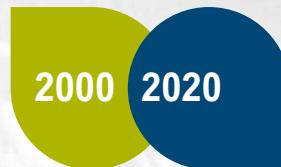
Sources: Roland Berger; UNHCR; ILGA; Human Dignity Trust

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

Human Freedom Index 2019

Less free – the trajectory of global human freedom: Since 2008, the level of global freedom has decreased slightly with **79 countries decreasing their level of freedom** and 61 countries in this index (a composite of 50% personal and 50% economic key indicators) increasing their ratings. **In particular, personal freedom indicators declined markedly vis-à-vis a significant increase in economic freedom**

Less freedom ▓▓ More freedom ⫽⫽ No data

Sources: Roland Berger; Cato Institute; Foresight Alliance

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 geo-political power, socio-economic evolution, and technology denote what lies ahead. Selected push-and-pull factors include:

> Whether **emerging middle classes grow** and whether they push for more rights (even if not full democracy) as historically has been the case – or not

> If **rising powers approach protecting human rights** (also beyond their borders) and adjust their own self-determination policies – 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

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Educational attainment has come a long way – Staying in education longer is now the new global norm and still growing to 2050

Educational attainment of global adult population[1] [share in %, total in bn]

1990: 3.6 bn — 22%, 29%, 41%, 8%

2020: 5.8 bn — 13%, 20%, 51%, 16%

2050: 7.9 bn — 6%, 13%, 56%, 25%
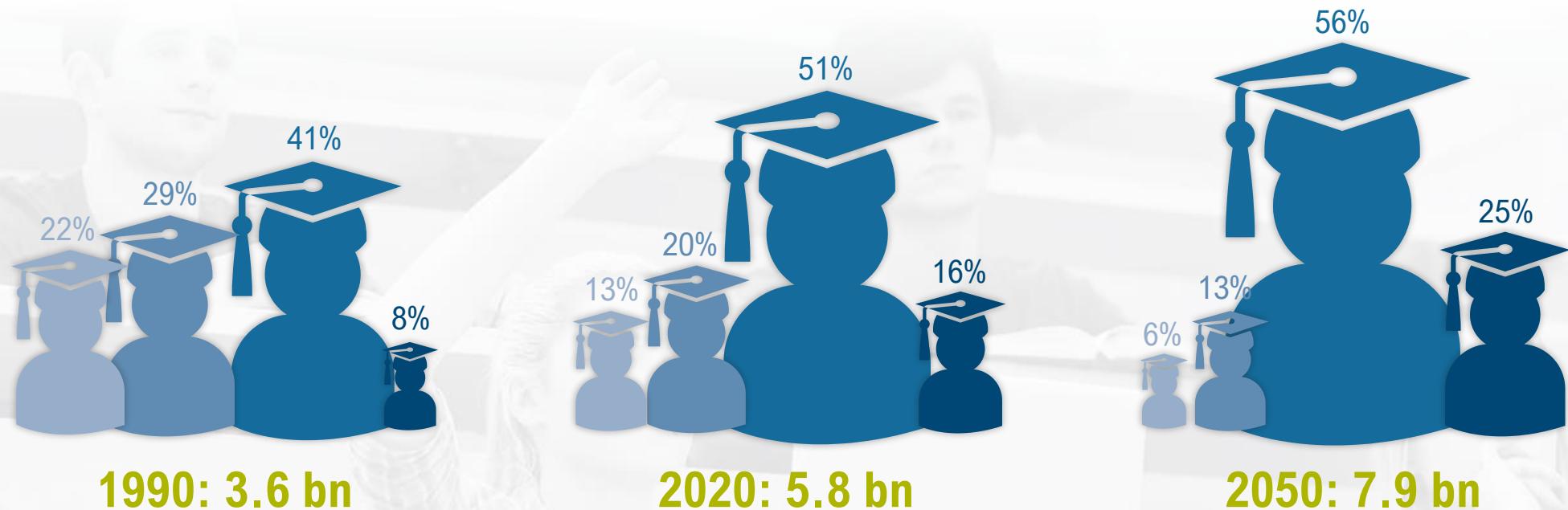
> Our world will be **inhabited by more and more educated people** as the share of people with no education decreases continuously
> By 2050, **only five countries are predicted to have a share of non-educated people that is >20%:** Burkina Faso, Ethiopia, Guinea, Mali, and Niger
> The changing level of educational attainment comes with **changing attitudes** towards education, **more public investments**, and **new methods**, such as the opportunity to study through online courses without the requirement of physical presence

No Education   Primary   Secondary   Post Secondary

1) People >15 years
Sources: Roland Berger; Wittgenstein Centre

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Globally speaking, it pays to stay in education longer, too – Length of education and financial prosperity correlate positively

Average number of years of education completed in 2020
related to GDP per capita PPP in 2019[1] [years, USD]

GDP per capita PPP [USD]
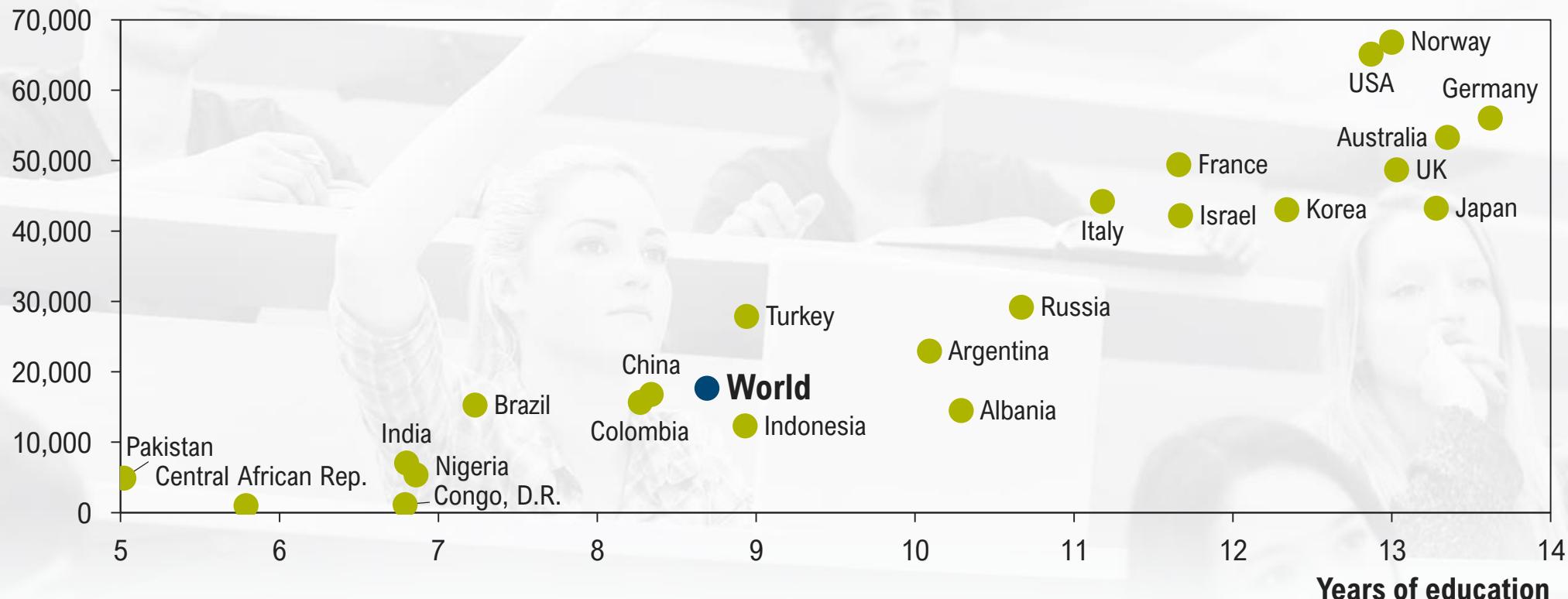
1) Number of years of education completed by people aged 25+ (medium variant). PPP stands for purchasing power parity. They are taken into consideration to create comparability across countries. Here measured in current international dollar
Sources: Roland Berger; Wittgenstein Centre; World Bank

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Megatrend 2
Health & Care

It doesn't stop at pandemics: Together, policy makers and health experts have to find solutions for myriad health and caregiving challenges

Subtrends of megatrend "Health & Care"

1

2

3

Pandemics & Other Wildcards

Diseases & Treatments

Care-giving

The scale of human tragedy along with the deep economic downturn due to COVID-19 demonstrates how vulnerable the world is to pandemics

Annual growth of global GDP [%]

Average growth 1980-2020: **3.3%**

Global Financial Crisis

COVID-19 Pandemic

-4.4%

1980 1985 1990 1995 2000 2005 2010 2015 2020
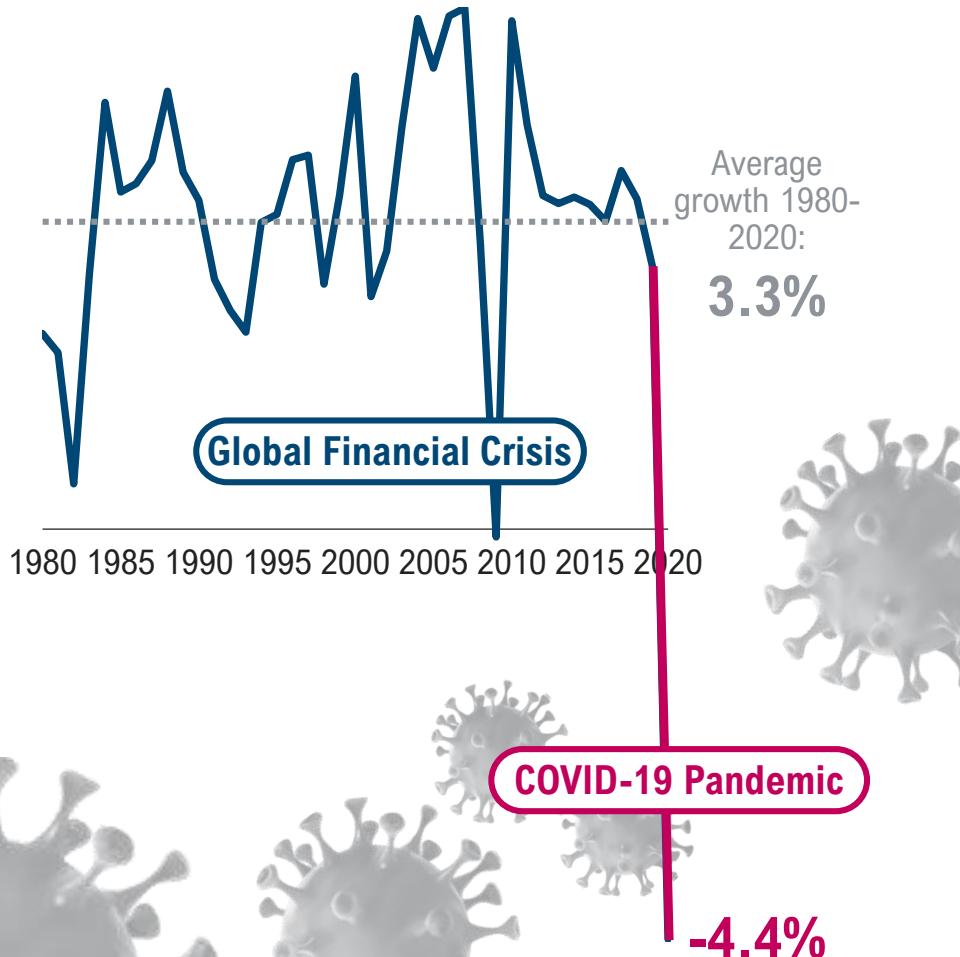
COVID-19 is not the first epidemic in the 21st century ...

2003: SARS
37 countries affected
9,100 infected
922 deaths

2009: H1N1 (Swine Flu)
169 countries affected
741,000 infected
18,449 deaths

2012: MERS
28 countries affected
2,600 infected
871 deaths

2014: Ebola
10 countries affected
28,600 infected
11,312 deaths

2015: ZIKA
55 countries affected
750,000 infected
45 deaths

2020: SARS-CoV-2[1]
191 countries affected
> 64,000,000 infected
> 1,500,000 deaths

… and is unlikely to remain the last

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But pandemics are not the only threat to global health – Numerous other challenges lie ahead on the way toward 2050

Selected global health challenges

1 The climate crisis as a health crisis

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

2 Anti-microbial resistance (AMR)

> Due to unregulated prescription practices and the overuse of antibiotics (among other factors), AMR is rising, jeopardizing achievements of modern medicine
> Both a more targeted use of antibiotics and the development of new antibiotics are key

3 Putting new technology to use

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

4 Providing global access to medicines

> One third of the global population lacks access to medicines, vaccines, and diagnostic tools
> Improving access to medication while ensuring its quality also requires fighting sub-standard and rogue products

5 Closing the global health care gap

> People in wealthier countries on average live 18 years longer than people in poorer countries
> It is paramount to improve access to primary care which addresses the majority of a patient's health needs

Sources: WHO; Roland Berger

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

Health spending per capita [USD, PPP]

2016 – Selected countries

Country	Value
Central African Republic	37
Afghanistan	200
India	246
Morocco	500
China	808
Brazil	1.864
Germany	5.619
USA	10.271

2016 – Income groups[1]

- 125
- 274
- 1.009
- 5.621

x 45
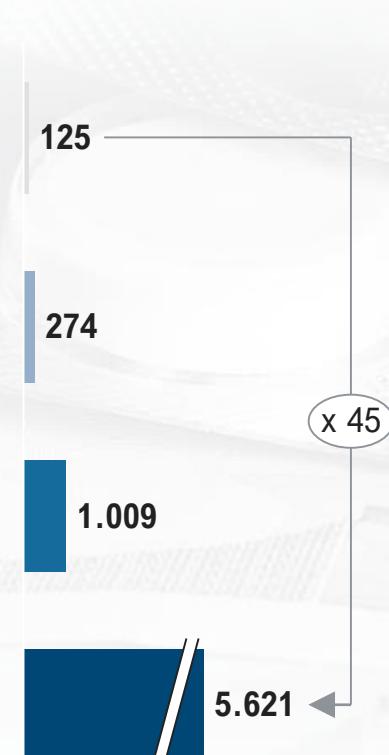
2050 – Income groups[1]

- 207
- 675
- 2.858
- 8.812

x 43
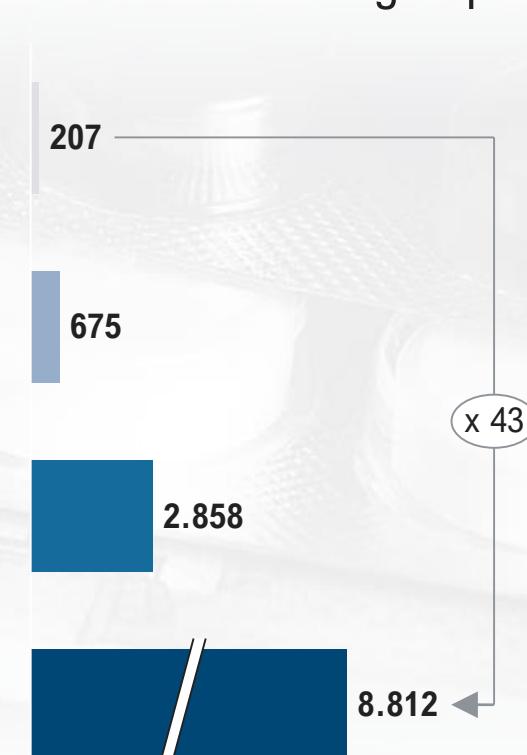
Low income   Lower-middle income   Upper-middle income   High income

1) Population-weighted averages
Sources: Global Burden of Disease Health Financing Collaborator Network; Roland Berger

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Globally, more than half of deaths are due to 9 diseases plus road injuries – Diseases of civilization and age such as dementia see strongest rises

The 10 leading causes of deaths, world, 2016 and 2045 [% of all deaths]

2016

%	Cause
13%	Ischemic heart disease
12%	Stroke
6%	Lower respiratory infections
6%	Chronic obstructive pulmonary disease
3%	Diarrhoeal diseases
3%	HIV/AIDS
3%	Trachea, bronchus, lung cancers
3%	Diabetes mellitus
3%	Road injury
2%	Hypertensive heart disease
47%	Other

2045

%	Cause
17%	Ischemic heart disease
11%	Stroke
6%	Chronic obstructive pulmonary disease
6%	Alzheimer disease and other dementia
4%	Lower respiratory infections
4%	Diabetes mellitus
3%	Trachea, bronchus, lung cancers
3%	Kidney diseases
2%	Cirrhosis of the liver
2%	Road injury
41%	Other

> In 2016 the **10 leading causes of deaths** have been responsible for **53% of all deaths globally**. By **2045**, this number is expected to increase to **59%.** With the exception of road injuries all of these causes are diseases

> **Diseases of civilization and age**, like ischemic heart disease, COPD, **Alzheimer's** or diabetes prevail. Due to demographic trends such as the aging of society, the rise of the global middle class, and an ongoing shift in lifestyles (e.g. more meat consumption, more sedentary etc.) the dominance of such diseases is growing

> **Alzheimer** disease and other forms of **dementia** – notably **not** among the top ten leading causes of deaths in 2016 – will climb to **fourth position in 2045**, responsible for **6% of all deaths globally**

> **Cancer** (malignant neoplasms) is responsible for 16% of global deaths in 2016 and **18% in 2045** (expected). It is not listed in the 10 leading causes of deaths as the WHO calculates the share for each single form of cancer. With 1.5% (2016) resp. 1.7% (2045) **liver cancer** causes the most cancer deaths

Sources: WHO; Roland Berger

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Between fiction and prediction: Advances in healthcare are subject to many expectations – But not all will materialize by 2050

Likelihood and impact of selected health predictions toward 2050 according to a 2020 survey of UCSF[1]

> Healthcare is one of the sectors with **highest levels of investment** in new technologies, new treatment options, and new drugs
> High level investments increase the **probability** for innovations to succeed, but many promising ideas nevertheless 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 **importance** 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. UCSF is a leading and highly ranked public research university dedicated exclusively to the health sciences. Five UCSF scientists have received the Nobel Prize in Medicine
Sources: UCSF; Roland Berger

Cell and gene therapies belong to the most promising innovations enabling restoration of biological function and treatment of 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[1] Therapy sales, 2019-2024E [EUR bn]

Gene Therapy
Cell Therapy

Year	2019	2020	2021	2022	2023	2024
Total	1.3	2.9	6.0	10.6	17.7	26.0
Gene Therapy	0.4	1.1	2.5	5.0	8.8	13.2
Cell Therapy	1.0	1.9	3.4	5.6	8.9	12.8
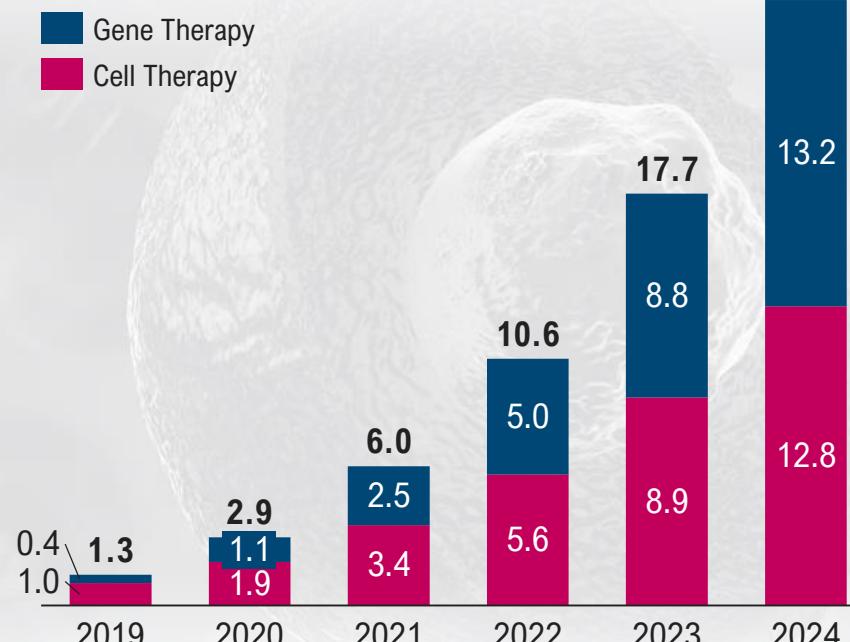
Cell & Gene Therapy opportunities

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 enhancement of cells, e.g. via local payload (e.g. cytokines) secretion

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

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The trend of increasingly age-related diseases such as dementia also points at a strong increase in the need for cost-intensive care

Population aged 80+ years [m]

426

146

+193%
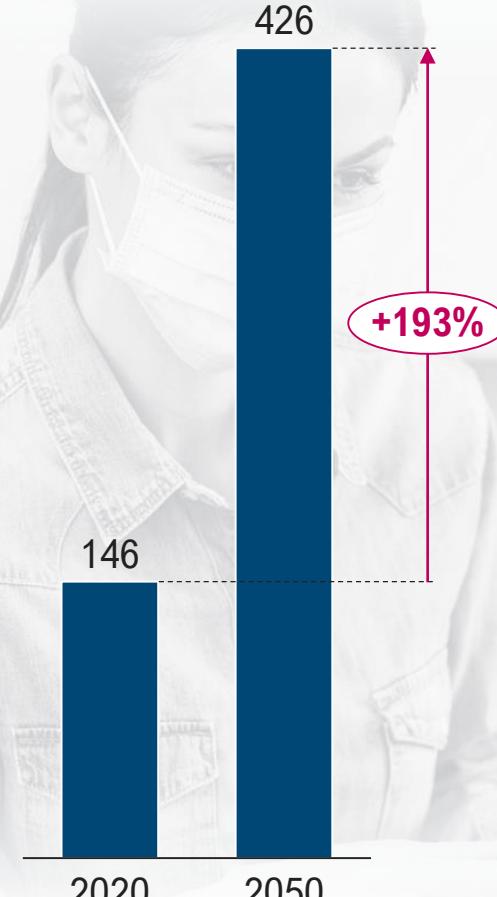
2020   2050

Global number of people living with dementia [m]

50   82   152

2018   2030   2050
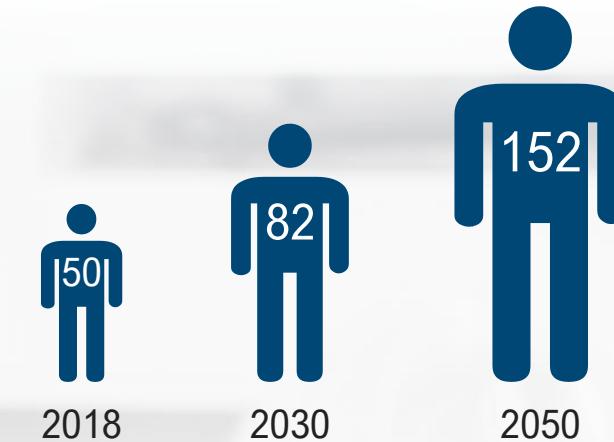
Worldwide cost of dementia [USD tr]

$ 1 tr $ 2 tr

2018   2030

> The world's **older population continues to grow**. Globally, the number of people aged 80 or older will **nearly triple** from 2020 to **2050** to **426 million**

> Many older people will be in good shape – but many won't. The share of older people in need of **specific, more intensive care** is growing

> An important example of such an old-age care-intensive disease is **dementia**. Early clinical symptoms 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**: doctors, caregivers, families, and society at large

> Currently around **50 million people are living with dementia globally**. This number is expected to **triple to 152 million by 2050**

> The next decade will 'only' see an increase of around 30 million people, but this will lead to **a doubling of the current global cost of USD 1 trillion to USD 2 trillion**

Sources: UN Population Division; WHO; Alzheimer's Association; Roland Berger

An increasing number of professional care givers is required to support the growing number of older people and their increasingly complex care needs

Example USA – Workforce of direct care workers 2008-2028 [m]

2.9 — 2008
4.5 — 2018
5.8 — 2028
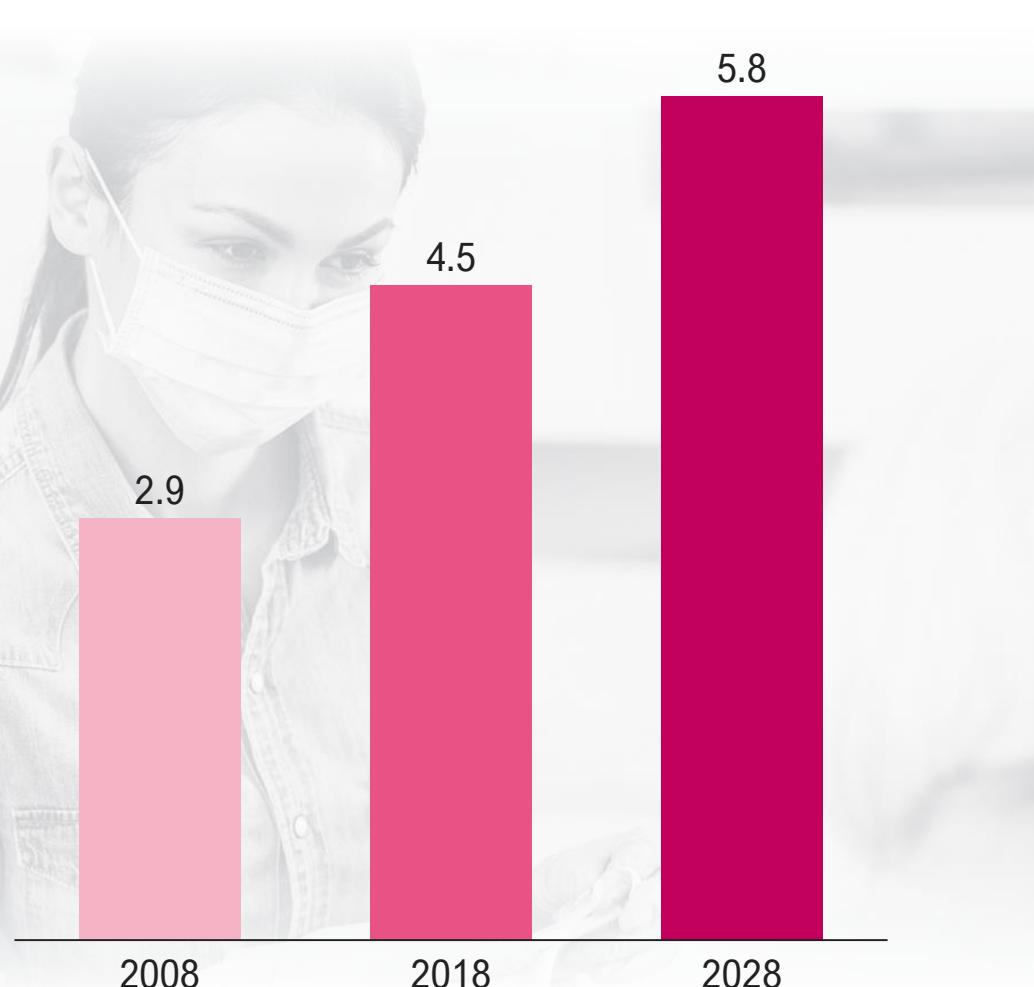
> Currently, nearly **20 million adults in the US require assistance with self-care** and other daily tasks due to physical, cognitive, developmental, and/or behavioral conditions; nearly 6 million US citizens are suffering from Alzheimer, the most common form of dementia. This number is expected to increase to nearly 14 million in 2050, with 75% of them requiring personal assistance

> Individuals with such care needs rely to the largest extent on **family** members, friends, and neighbors – a support network of more than **43 million informal caregivers** whose economic contribution is **valued at USD 470 billion**. But for those with limited care support, or with more complex needs, **paid direct care workers are a lifeline**

> **Direct care workers** – encompassing personal care aides, home health aides, and nursing assistants, etc.– provide assistance with daily routine activities (e.g. bathing, dressing, eating) and auxiliary activities of daily life (such as preparing meals, housekeeping, managing medications, and attending appointments, etc.)

> The **already sizable direct care workforce in the US** is expanding rapidly as the older population grows and lives longer with chronic conditions and disabilities, while the supply of potential family caregivers dwindles. The workforce has already nearly doubled within a decade, from 2.9 million workers in 2008 to **almost 4.5 million in 2018**

> The long-term care sector is expected to add **a further 1.3 million direct care jobs** in primarily personal care positions, from 2018 **to 2028** – more new jobs than in any other US occupational category

Sources: PHI; Alzheimer's Association; US Department of Health and Human Services

Roland Berger

Megatrend 3
Environment & Resources

Upping global climate change mitigation is a must, in the future, water, food, and raw materials face critical issues, biodiversity is underfunded

Subtrends of megatrend "Environment & Resources"

1
Climate Change & Pollution

2
Resources & Raw Materials

3
Ecosystems at Risk

Roland Berger

Manmade global temperature increases can only be limited to 2°C if significant additional efforts are undertaken to become carbon-free in 2100

CO_2/Temperature increase nexus

Global temperature anomalies compared to the average global temperature in the 20th century [left scale, °C] and CO_2 concentration in the atmosphere [right scale, ppm]

CO₂ concentration

Temperature
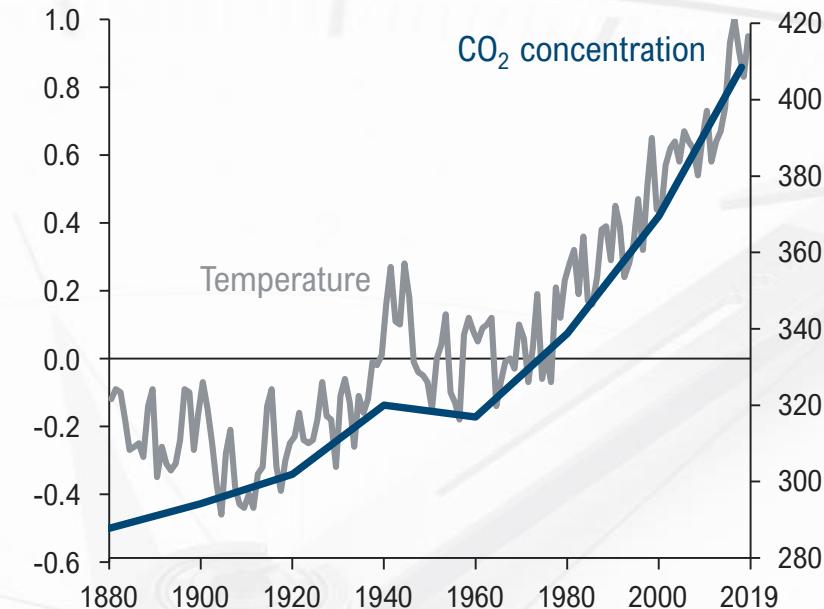
How to reach the Paris goal (Global warming < 2°C)

Global CO_2 equivalent emissions under different scenarios [GtCO₂e]

Scenarios

Global temperature increase in 2100[1]
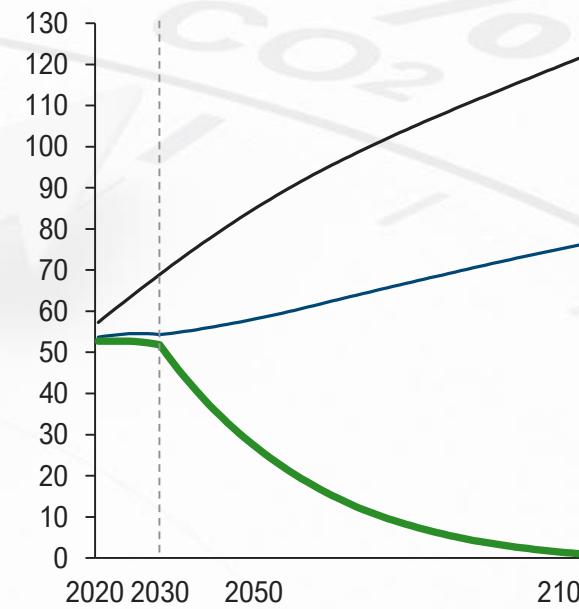
Business as usual — **4.1°C**

Pursuit of national/regional pledges until 2030, without additional actions/reductions thereafter

Pursuit of national/regional pledges until 2030 with additional reductive actions thereafter — **1.8°C**

Is the limit of 2°C enough?

To keep the global warming below 2°C had long been regarded as the right target measure to limit the most dangerous risks. More recently, **1.5°C has been considered safer**, which requires rapid, far-reaching, and **unprecedented changes across all aspects of society**

1) Compared to the pre-industrial temperature level
Sources: NOAA; Climate Interactive; IPCC; Roland Berger

Roland Berger

CO_2 dominates 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 2016[1]

- Others 2%
- Nitrous dioxide 6%
- Methane 17%
- CO2 74%
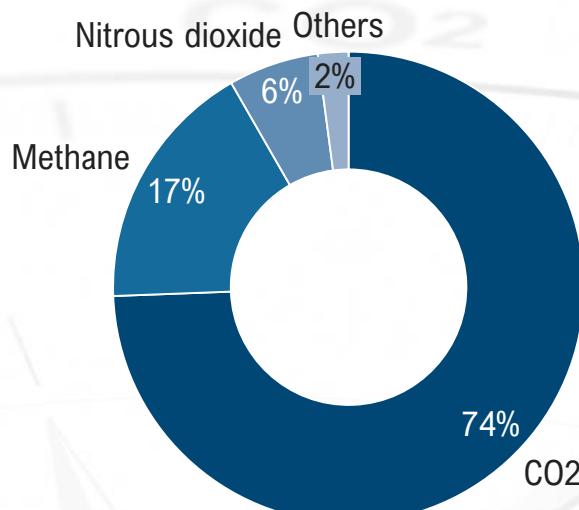
Biggest GHG emitters 2016

- China 26%
- USA 13%
- EU 8%
- India 7%
- Russia 5%
- Japan 3%
- Brazil 2%
- Indonesia 2%
- Iran 2%
- South Korea 2%
- Others 32%
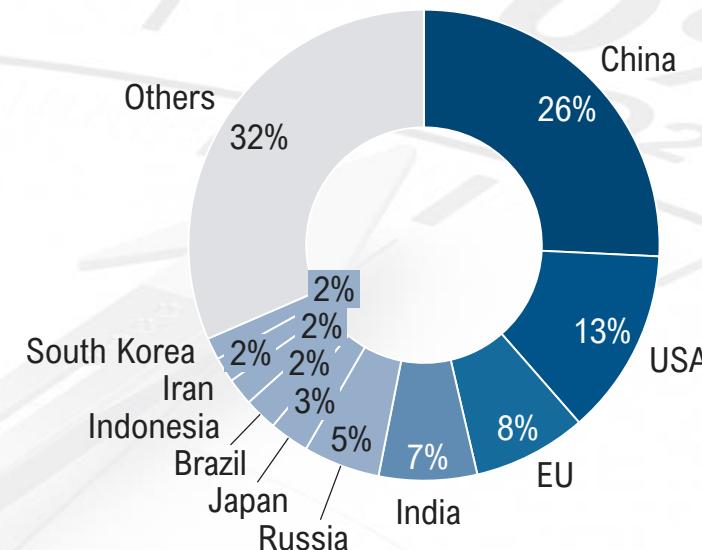
Sources of global GHG emissions 2016

- Energy use in industry 24%
- Agriculture, forestry & land use 18%
- Energy use in buildings 18%
- Energy use in transportation 16%
- Misc. energy use 14%
- Industry 5%
- Waste 3%
- Energy use in agriculture 2%
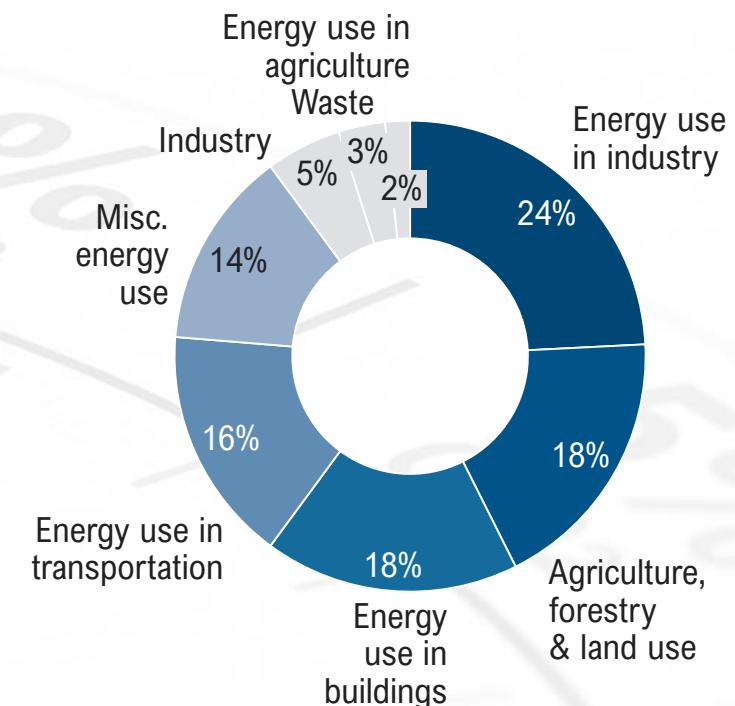
Global GHG emissions 2016: 49.4 GtCO$_2$e

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 (smart supply chains, smart mobility and logistics, smart cities)

Roland Berger

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
Examples	Fine dust, sulfur dioxide, carbon monoxide, nitrogen oxides, ozone, chemical vapors, pollen, radioactive air pollutants	Waste (particularly plastics) and sewage, bacteria, oil, chemicals, pesticides and herbicides, fertilizer, tire abrasions, metals, drugs	Liquid, solid or sludge waste i.e. open dump or landfill; microplastics in sewage sludge used as fertilizer; pesticides, herbicides, heavy metals	Traffic noise, flight paths, heavy industry, mining, construction sites	Over-illumination of streets/places/buildings/ industrial plants
Selected origins	Fuel combustion for energy production/transportation/ heating etc., non-exhaust vehicle emissions; natural, chemical and nuclear catastrophes	Industry and household sewage, mines, vehicles (e.g., ships/oily water and garbage), agricultural runoff, spillages	Industry, households, mines, agriculture	Vehicles, aviation, industrial plants, mining, construction machinery	Public and private infrastructure

| 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 tr pieces of plastic in an area of 1.6 m km^2 – 3x the size of France | Globally, 33% of waste is still openly dumped and approx. 40% goes to **landfills** | #1 cause of the 466 m people globally suffering from disabling hearing loss is mostly work-related **noise** – not age | 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

Roland Berger

An inconvenient truth about energy consumption: Unless coordinated efforts change global patterns, fossil fuels still top the 2050 energy mix

Global energy consumption according to the EIA International Energy Outlook (IEO) 2020

By fuel
World [quadrillion Btu]

Legend (By fuel):
- Coal
- Natural gas
- Petroleum & other liquids[2]
- Nuclear
- Renewables[3]
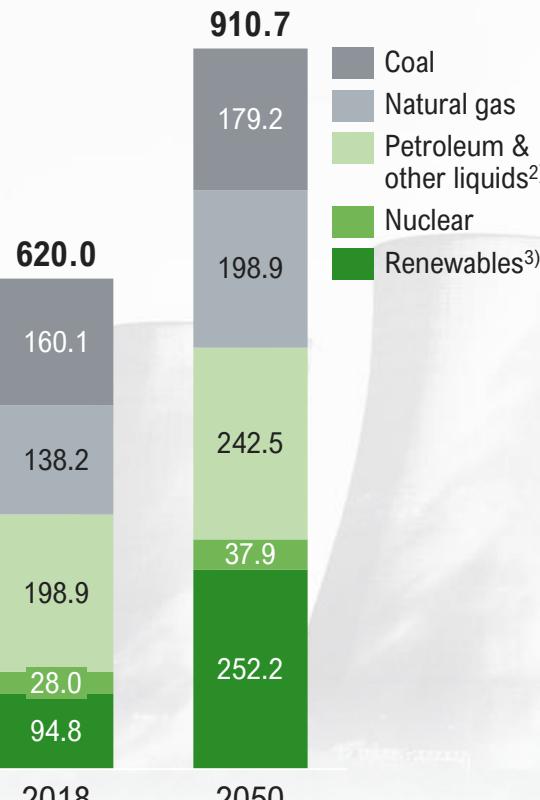
By region
World [quadrillion Btu]

Legend (By region):
- OECD Americas
- OECD Europe
- OECD Asia
- Non-OECD Americas[2]
- Non-OECD Europe & Eurasia[3]
- Non-OECD Asia
- Middle East
- Africa
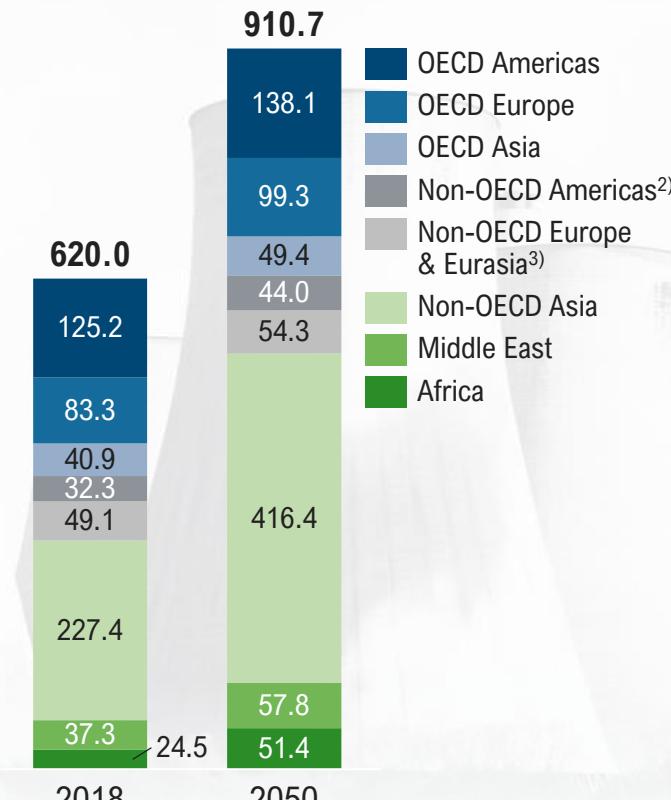
The IEO 2020 is based on the following assumptions[1]
> Current views of economic and demographic trends, and improvements in known technology
> Implementation of current laws and regulations

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. the introduction of CO_2 pricing) while ensuring its global competitiveness
- … more **energy efficiency** measures geared at stopping the increase of overall global consumption
- … more **technological innovations and solutions**, and an **open discussion** regarding potential consequences (e.g. new grids, hydrogen pipelines etc.)
- … to **pay the price for climate protection**, i.e. an understanding and acceptance of a loss of prosperity

1) The IEO 2020 is based on the IEO 2019 modeling platform focusing on longer-term market dynamics not including the impact of the COVID-19 pandemic 2) Includes biofuels 3) Except biofuels
Sources: EIA; Roland Berger

Roland Berger

The demand for water and food is expected to grow significantly toward 2050 – Higher efficiency and further levers could mitigate its growth (1/2)

Global water demand 2015[1] vs. 2050 [km^3]

2015
4,135 km^3

+32%

2050
5,467 km^3

55%   20%   13%   12%   1%

37%   25%   22%   14%   1%

🔵 Irrigation 🔵 Electricity ⚪ Manufacturing 🟢 Domestic 🟢 Livestock

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) The values for 2015 are linearly extrapolated with the values for 2000 and 2050   2) BRIICS: Brazil, Russia, India, Indonesia, China, South Africa   3) RoW = rest of the world
Sources: OECD; Roland Berger

Roland Berger

The demand for water and food is expected to grow significantly toward 2050 – Higher efficiency and further levers could mitigate its growth (2/2)

Global food demand 2015[1] vs. 2050 [km^3]

Food
Main drivers of demand

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

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) …

… **56% more** crop calories being produced

2010 | 2050 | 56% more

The food gap

… **593 m ha** more agricultural land – twice the size of India

2x size of India

The land gap

… **11 GtCO$_2$e GHG** emissions p.a. in 2050 from agriculture and land-use change[1] need to be limited down to 4 GtCO$_2$e p.a. in order to to meet the 2°C Paris goal

12 (2010) | 15 (2050) | 11 GtCO$_2$e/y | 4

The GHG mitigation gap
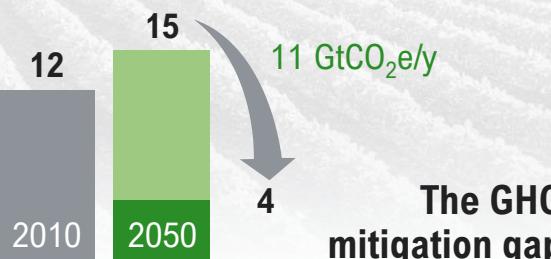
Food
Main levers to close the gaps

> 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

Roland Berger

People & Society
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3. Values
4. Education

Health & Care
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3. Caregiving

Environment & Resources
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2. Resources & Raw Materials
3. Ecosystems at Risk

Economics & Business
1. Globalization Revisited
2. Power Shifts
3. Sectoral Transformation
4. Debt Challenge

Technology & Innovation
1. Value of Technology
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Politics & Governance
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3. Global Risks

Water, food, and energy resources aside, a high number of raw materials are critical for our economy – China is the dominant supplier

An analysis of the EU: Countries accounting for largest share
of global supply of critical raw materials (CRM) 2020[1] [%]

France
> Hafnium (49%)

Spain
> Strontium (31%)

USA
> Beryllium (88%)

Chile
> Lithium (44%)

Brazil
> Niobium (92%)

Russia
> Palladium (40%)

Turkey
> Borates (42%)

Thailand
> Natural rubber (33%)

D.R. of Congo
> Cobalt (59%)
> Tantalum (33%)

South Africa
> Iridium (92%)
> Platinum (71%)
> Rhodium (80%)
> Ruthenium (93%)

China
> Antimony (74%)
> Baryte (38%)
> Bismuth (80%)
> Coking Coal (55%)
> Fluorspar (65%)
> Gallium (80%)
> Germanium (80%)
> Indium (48%)
> Magnesium (89%)
> Natural graphite 69%)
> Phosphate rock (48%)
> Phosphorus (74%)
> Scandium (66%)
> Silicon metal (66%)
> Titanium (45%)
> Tungsten (69%)
> Vanadium (39%)
> Light REEs[2] (86%)
> Heavy REEs (86%)

The EU analysis concerning CRMs

> Since 2011 the **EU reports on the global supply of raw materials**
> The 2020 (fourth) assessment covers 80+ raw materials with a view to these being **critical** – or not – for the **EU**
> The EU defines a raw material as critical when its **economic importance** and its **supply risk** is **high**
> At present, the EU identified **30 raw materials or raw material groups as critical**

Looking ahead to 2050

Demand for **rare earths** used in permanent magnets, e.g. for electric vehicles, digital technologies or wind generators, could **increase tenfold by 2050.** By 2050, the EU will require around **60 times more lithium**, essential for e-mobility, and **15 times more cobalt**, used in electric car batteries

Selected CRMs and examples of end-use

Beryllium: electronic and telecommunications equipment; Germanium: infrared optics; Hafnium: superalloy; Niobium: magnets; Rhodium: auto catalyst; Phosphate rock: mineral fertilizer; Tantalum: capacitors; Tungsten: tools

1) Percentage shares refer to the study "Report on critical raw materials for the EU" (2020), European Commission 2) REEs: Rare Earths Elements
Sources: European Commission; Roland Berger

Roland Berger

Biodiversity is declining: One third of terrestrial species have been lost to date – The need to tackle rising pressures such as climate change is high

Terrestrial mean species abundance loss 2020 and 2050 for selected regions and countries[1] [% loss compared to pristine ecosystem]
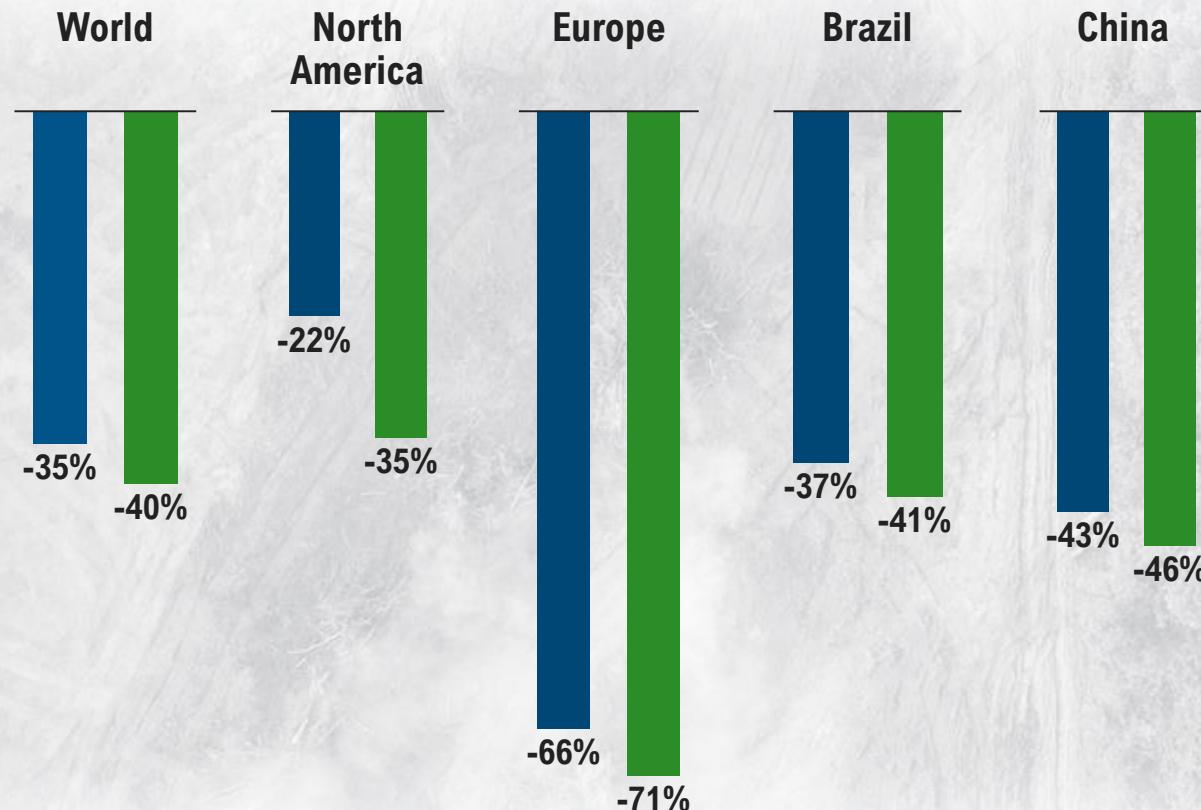
Relative share of pressures to additional terrestrial biodiversity loss 2010-2050[1] [%]

World
-35% (2020)
-40% (2050)

North America
-22% (2020)
-35% (2050)

Europe
-66% (2020)
-71% (2050)

Brazil
-37% (2020)
-41% (2050)

China
-43% (2020)
-46% (2050)

Legend:
- Climate change
- Forestry
- Bioenergy
- Infrastructure, encroachment, fragmentation
- Former land use
- Nitrogen
- Food crop
- Pasture

2010-2030
33%, 15%, 1%, 19%, 11%, 2%, 17%, 3%

2030-2050
39%, 26%, 12%, 11%, 11%, 0%, 1%
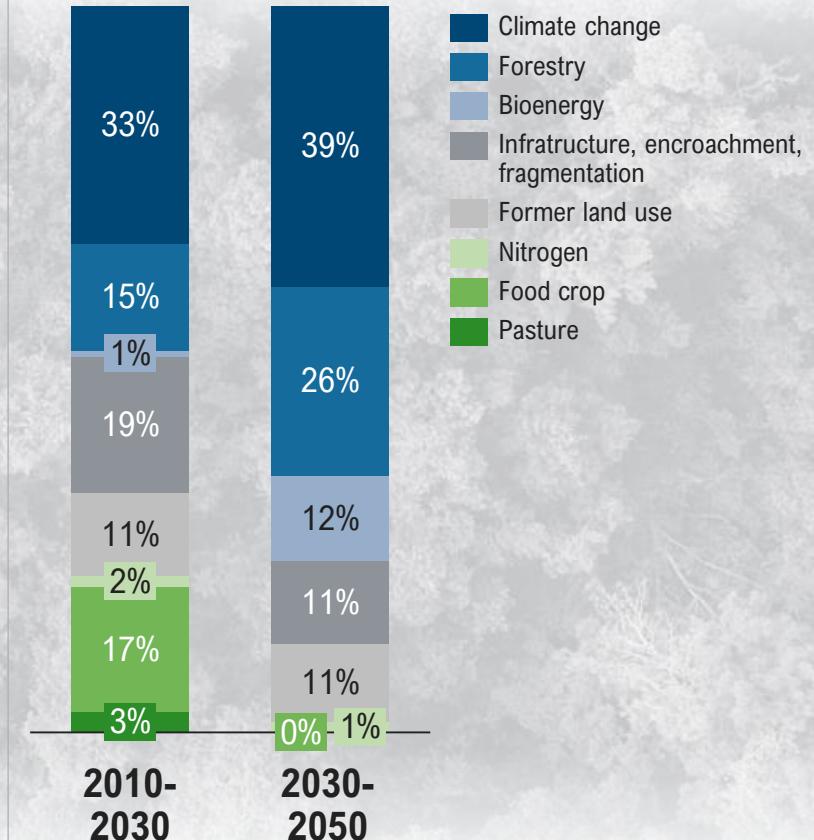
Legend: ■ 2020 ■ 2050

1) According to the Baseline scenario of the OECD, which includes steady GDP growth and a strong ongoing use of fossil fuels
Source: OECD

Roland Berger

Sustainable biodiversity is a 'must have' – For our planet but also 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

Two **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 CO_2 on average over their lifetime. Together with other economic effects such as fishery enhancement, ecotourism, and phytoplankton productivity (capturing 37 billion tons CO_2 p.a.), the IMF puts 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**

USD 235 - 577 bn p.a.

USD 1 tr

Sources: UN/IPBES; WEF; IMF

Roland Berger

… 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 **governmental expenditures on activities harmful to biodiversity** in the form of agricultural, forestry, and fisheries subsidies – USD 274-542 billion p.a. in 2019 – are **two to four times higher than annual capital flows toward biodiversity conservation**

Biodiversity financing gap **USD 711 bn**

844.5

133.5

Global biodiversity conservation financing in 2019

Global biodiversity conservation financing needs by 2030

■ Lower limit   ■ Upper limit   ● Middle point
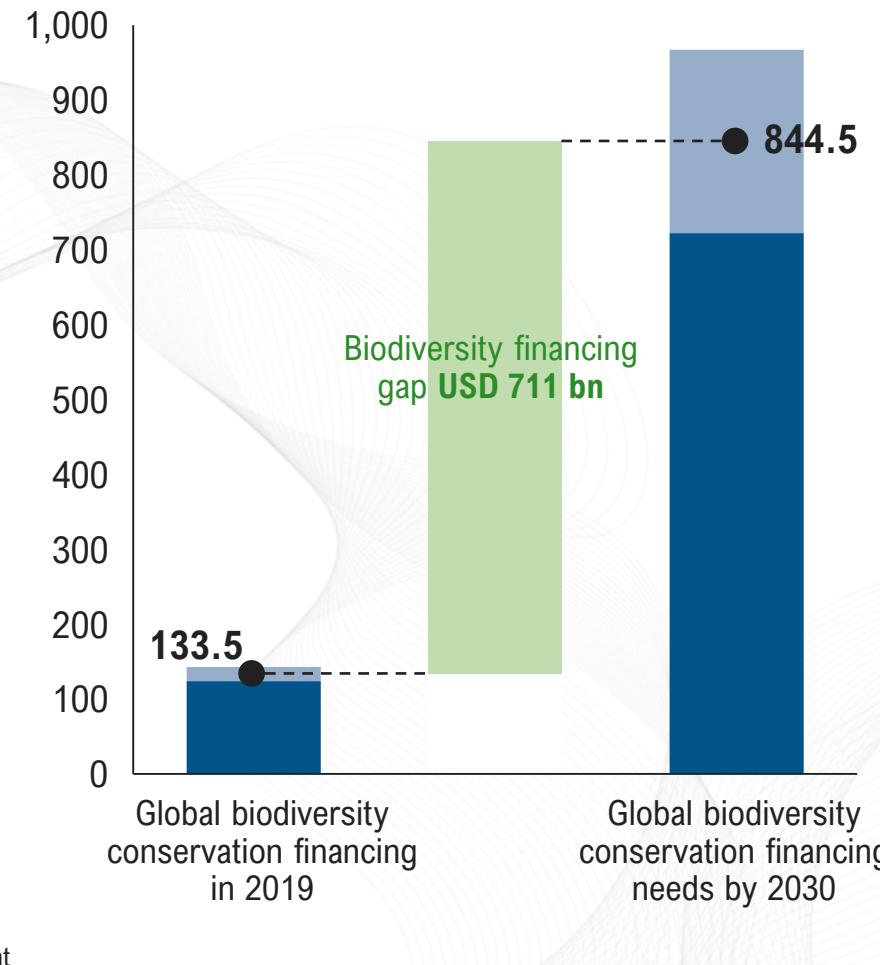
Future biodiversity spending needs and levers

> We need to spend **USD 722–967 billion p.a.** to **halt the decline** in global biodiversity between now and 2030

> This leaves an estimated global **biodiversity financing gap of USD 598-824 billion p.a.** – roughly equal to just under one percent of annual global GDP

Sources: Paulson Institute/Cornell/Nature Conservancy

Roland Berger

Megatrend 4
Economics & Business

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

Subtrends of megatrend "Economics & Business"

1   **2**   **3**   **4**

Globalization Revisited

Power Shifts

Sectoral Transformation

Debt Challenge

Roland Berger

Global trade has long been the engine of globalization and growth – But since the Global Financial Crisis growth rates of trade have nearly halved

Global trade has cooled off after 2009

Average yearly growth of global exports (goods and services), real, [CAGR, %]

GFC 2009

- 7.0 (1999-2008)
- 3.8 (2010-2019)

Average yearly growth of global GDP, real, PPP [CAGR, %]

GFC 2009

- 4.1 (1999-2008)
- 3.4 (2010-2019)
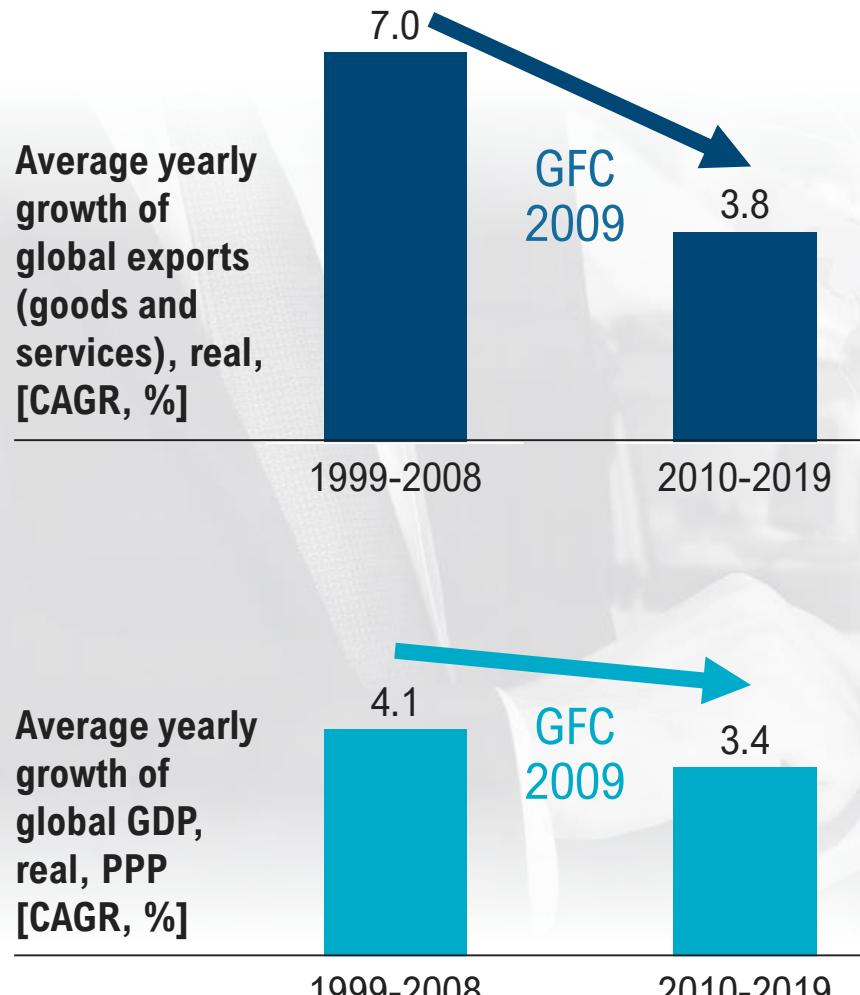
Multiple factors are slowing global trade

Globally, the cumulative number of harmful trade interventions has increased sizably – from less than 3,000 in 2010 to more than 20,000 in 2020

- 2,874 (2010)
- 11,318 (2015)
- 20,320 (2020)
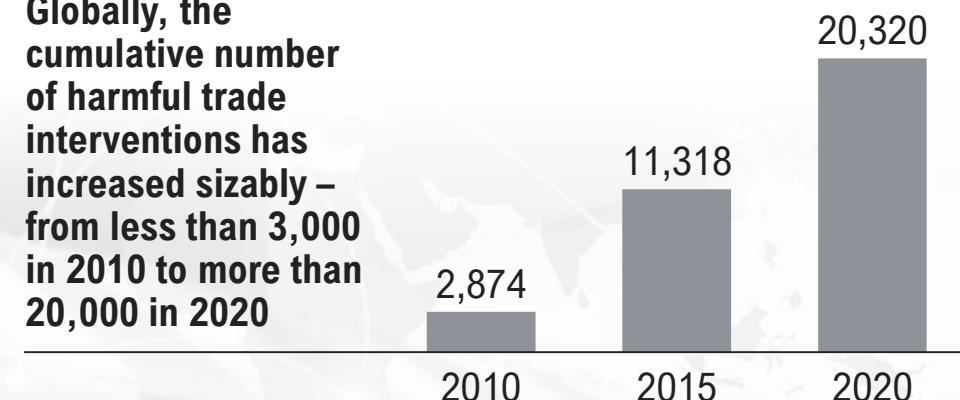
> An important driver of **trade barriers** has been a change in outlook and the **subsequent trade wars** between US and the EU/China

> In addition, the **Corona crisis** has created huge uncertainty and **added additional barriers to the flow of trade**

> But free trade in goods has not just been stagnating since the Trump administration: probably the most prominent trade agreement, the **US-European TTIP, failed during the Obama administration**, not least due to European concerns

> **Sanctions**, such as directed at Russia due to the conflict in the Ukraine and the annexation of Crimea, are a burden to **global trade**

> Moreover, the **European** trade agreement with South American **MERCOSUR** countries has also been stalling for some time due to European concerns

Sources: Oxford Economics; Global Trade Alert; Roland Berger

Roland Berger

Mirroring global trade developments, global supply chains also weakened while domestic production gained prominence

Shift in global supply chains towards domestic production

Domestic share of value added as a proportion of a country's/region's total exports 2011 and 2015 [%]
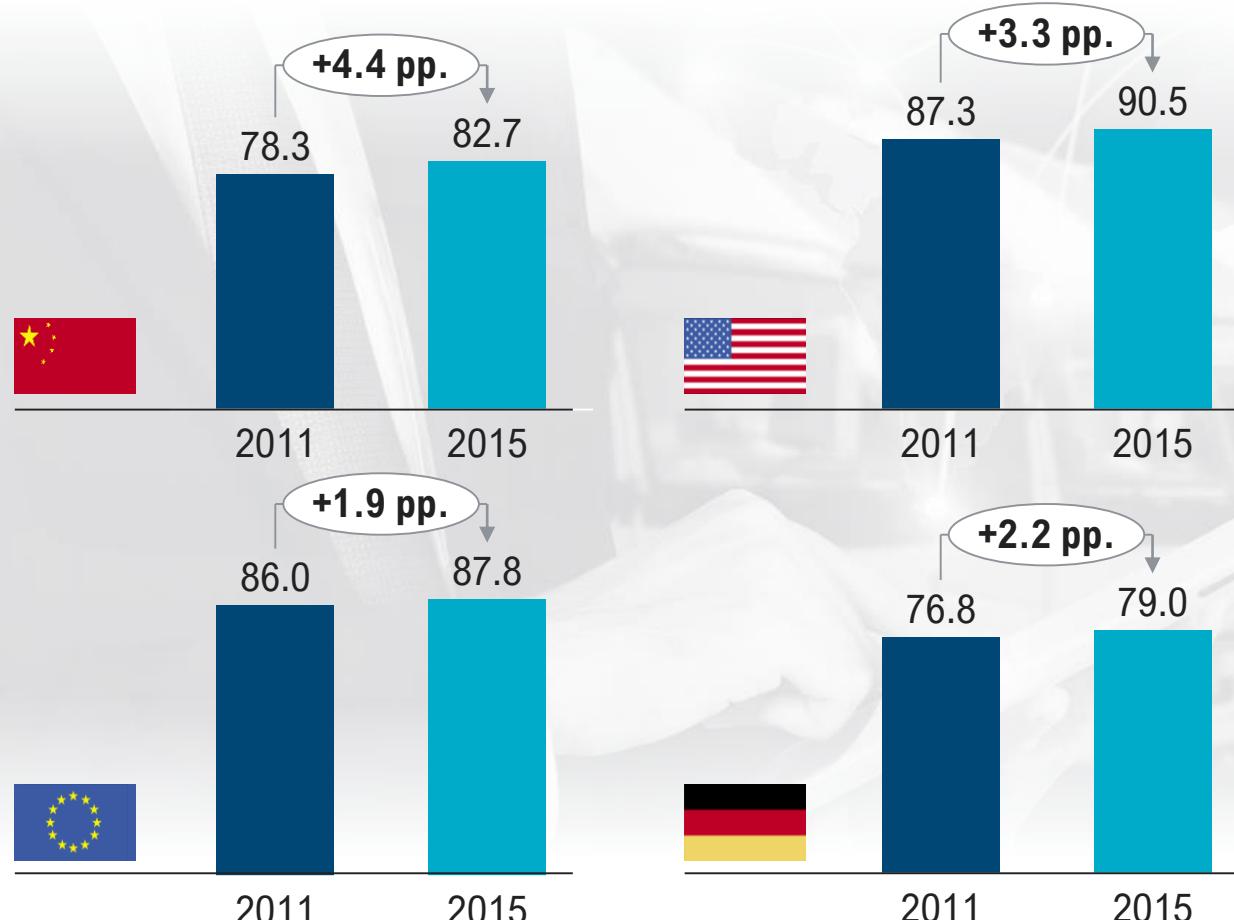
> The **Corona crisis** has cruelly exposed all the **weaknesses of the international labor division**. A massive supply and demand shock at the beginning of 2020 brought many economies to a standstill
> However, the **decline of the importance of global value chains** had already started **half a decade earlier**
> **China's economy moved up the value chain** and replaced imports of intermediate products through domestic production
> In the **US, the EU and Germany** the substitution of foreign imports of intermediate products with more domestic production is less pronounced, but equally evident
> The trend toward **regionalization** or even reshoring of production comprises **different causes** such as a **reduction of wage differentials,** a higher importance of **transport cost**, the pursuit of domestic production for essential **goods,** or the aim of a more **sustainable production** with shorter transport routes

Sources: OECD; Roland Berger

Trend overview

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Economic power is shifting further toward emerging countries – With RCEP, Asia-Pacific countries set the course for a global economic power bloc

In 2050, 3 of the top 5 global economic players will stem from emerging markets

Geographically, Asia reaffirms its position at the center of global economic power

Top 10 countries in terms of nominal GDP in 2019 and 2050 [USD bn]

GDP 2019 GDP 2050

Country 2019	GDP 2019	GDP 2050	Country 2050
USA	21,433	90,805	China
China	14,330	64,232	USA
Japan	5,083	34,339	India
Germany	3,868	9,928	Indonesia
India	2,835	9,869	Germany
UK	2,828	9,721	Japan
France	2,717	8,738	UK
Italy	2,003	6,853	France
Brazil	1,839	5,872	Canada
Canada	1,736	5,800	Russia

> In November 2020, the **Regional Comprehensive Economic Partnership (RCEP)** formed by the **ten** ASEAN member states plus **five** other countries in the Asia-Pacific region, including China, Japan, South Korea, New Zealand and Australia, was announced

> The agreement **accounts** for almost **30 percent of world trade** with the countries involved representing around 2.2 billion people, making the agreement the largest free trade area in the world – ahead of the EU

> RCEP is clearly a competitive force amongst free trade areas, but equally a new opportunity for its members and other such 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 bilateral or country-level agreements

Sources: Oxford Economics; EEAS; Roland Berger

Roland Berger

From a sectoral point of view, transformation is the key challenge – Main drivers are decarbonization and new technologies

Transformation of selected sectors: Main drivers

Automotive
> Increased political and public pressure and stricter regulation to reduce **carbon footprint**
> Technological **innovations**, especially in areas of new propulsion technologies (electrification, fuel cells), autonomous driving, increased digitalization, connectivity, and artificial intelligence
> Increasing demand for **new mobility services**, rise of the **sharing** economy

Utilities
> Carbon reduction goals/**carbon pricing** leading to devaluation of existing fossil fuel-based assets and high investments in new assets (renewables)
> **Decentralization** of energy production
> **Increasing energy demand** in emerging economies due to the emerging middle class
> Increasing **electrification** and **new business models** due to **sector coupling**

Aerospace
> Declining demand for aircrafts as aviation is seen as a **major climate killer** by the public and regulators
> **New technologies** like electric propulsion of aircrafts
> **New design, manufacturing, and service concepts**
> **Enhanced safety requirements** triggered by aircraft-related accidents

Financial Services
> **New technologies** such as AI, blockchain, cloud computing
> **Increased competition** due to new players such as Fintechs and new business models e.g. peer-to-peer-financing
> **New analytics opportunities** like big data, customer intelligence

Source: Roland Berger

Roland Berger

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Financially, the global economy is burdened by increasing debt levels – Post-COVID, it is unclear how to deleverage

Global Debt 2000-2030 [USD tr]
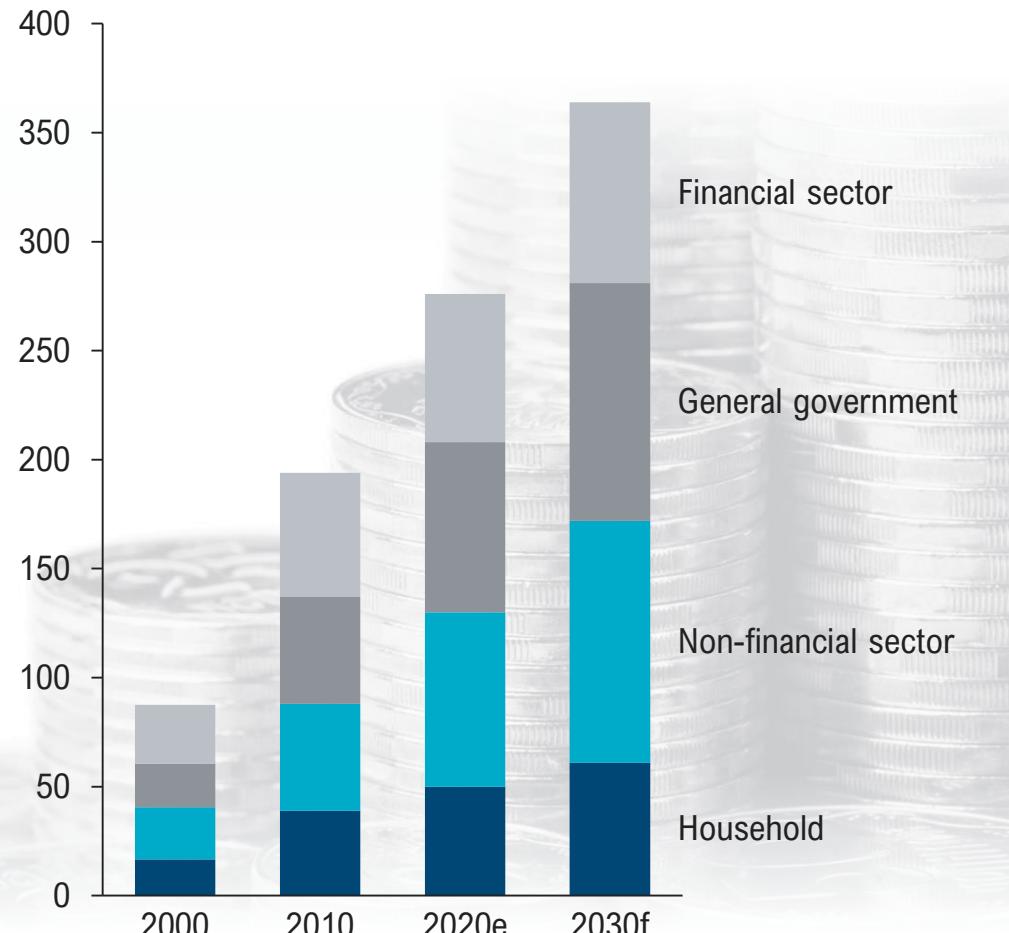
> The **Corona pandemic** caused a **sharp rise in government and corporate borrowing.** Experts estimate that **global debt** (across all debt) is set to increase by USD 20 trillion at the **end of 2020** year on year, to reach **USD 277 trillion** (365% of global GDP)

> In Q3 2020 global debt of households is estimated at USD 49.2 trillion, of non-financial corporates at USD 79.6 trillion, of general government at USD 77.6 trillion, and of the financial sector at USD 66.3 trillion. **Governments accounted for 43% of the USD 20 trillion increase** of global debt from Q3 2019 to Q3 2020

> The pace of **global debt accumulation** has been **unprecedented since 2016**, increasing by an estimated amount of more than USD 52 trillion. While a significant part of this surge can be attributed to the 2020 Corona pandemic, the **prior 2016-2019 debt build-up** has already far **outstripped** the USD 6 trillion rise over the previous four years and over **earlier comparable periods**

> **What about the future?** There is significant **uncertainty about how the global economy can deleverage** without significant adverse implications for economic activity. The next decade could bring a reflationary fiscal response, in sharp contrast to the austerity measures exerted in the 2010s. If the global debt pile continues to grow at the average pace of the last 15 years, experts estimate that global debt could exceed **USD 360 trillion by 2030**

Source: Institute for International Finance

Roland Berger

Megatrend 5
Technology
& Innovation

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

Subtrends of megatrend "Technology & Innovation"

1

2

3

Value of Technology

Artificial Intelligence

Humans & Machines

Roland Berger

Technology and innovation drive prosperity – A lack of such capabilities is a major hurdle for developing countries to level with developed countries

Bloomberg Innovation Index 2020 related to GDP per capita PPP in 2019[1] [innovation index, USD]

GDP per capita PPP [USD]

[Scatter plot: x-axis "Bloomberg Innovation Index" from 40 to 90, y-axis "GDP per capita PPP [USD]" from 0 to 70,000. Data points labeled: Norway, USA, Australia, Germany, France, UK, Italy, Israel, Japan, South Korea, Turkey, Malaysia, Russia, Argentina, China, Mexico, Brazil, South Africa, Morocco, Tunisia, India]

Bloomberg Innovation Index
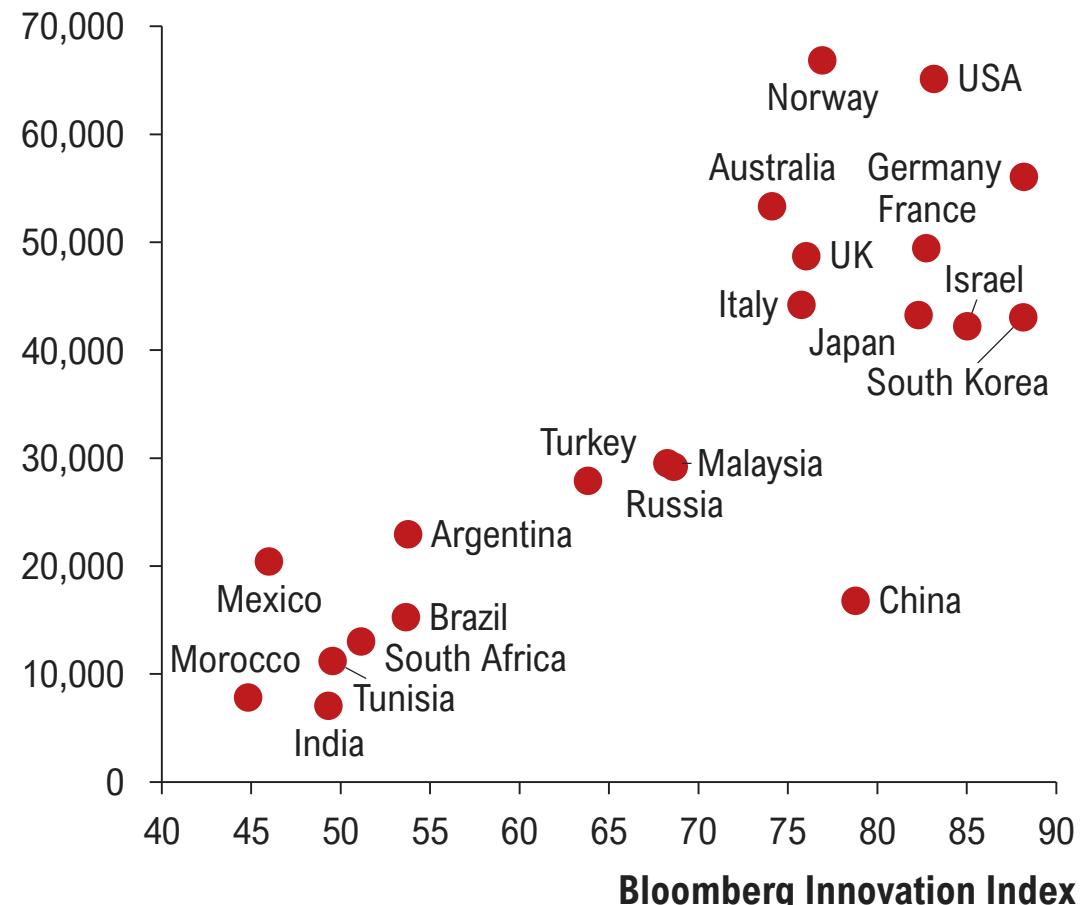
> The **innovative** capability of a nation is an essential engine of **productivity, growth, and prosperity**

> The **Bloomberg Innovation Index 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 activity, tertiary education efficiency, manufacturing value-added, productivity, high-tech density, and researcher concentration

> Evaluating the Bloomberg Innovating Index from a GDP 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 has a comparably lower GDP/capita – largely due to relatively lower levels of income among the rural population

> Many **developing countries lack 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 seen in developed countries – are notably absent

> A stark illustration of this gap is can be found in the number of articles published in technological and scientific journals: In 2013, in the **least developed countries** of Africa **only 7 articles** were **published** per 1 million people. In **OECD** member countries, the comparative number totaled **1,100** for every 1 million people

Roland Berger

High levels of investments made by developed countries demonstrate that technology remains key – Catch up by developing countries will be difficult

Selected investments in technology

US and China have invested **USD 92 billion** and **USD 22 billion** respectively in emerging technologies over the last 5 years

China has announced an investment of **USD 1.4 trillion** by **2025** in developing **AI** software and installing **5G** networks

91% of investments in **emerging technologies** made in 2015-2019 have come from **10** countries[1]

EU is to invest **USD 10.9 billion** (2021-2027) in digital transformation, including **AI, supercomputing, cyber-security** and **digital skills**

Plans of **Biden's** administration include doubling the federal R&D spending to **USD 300 billion** over **4 years**

AI attracts the most investment globally, securing **USD 23 billion** in 2019, with investment forecast to reach **USD 110 billion** in 2024

Part of a larger post-COVID stimulus package, **Germany** is planning to invest **USD 2.4 billion** in **quantum technology**

1) Emerging technologies include AI, robotics, cybersecurity, blockchain, IoT, VR and AR
Sources: UN; Fortune; CNET; Roland Berger

What lies ahead? A significant number of emerging technologies is based on Artificial Intelligence

Gartner Hype Cycle for Emerging Technologies, 2020[1]

Expectations

- Secure Access Service Edge (SASE)
- Social Distancing Technologies
- **Embedded AI**
- **Explainable AI**
- Data Fabric
- Composable Enterprise
- Carbon-Based Transistors
- **AI Augmented Development**
- **Responsible AI**
- Multiexperience
- Digital Twin of the Person
- Citizen Twin
- Packaged Business Capabilities
- Bring Your Own Identity
- **Generative AI**
- **Composite AI**
- Adaptive ML
- Social Data
- Private 5G
- Generative Adversarial Networks
- Differential Privacy
- Ontologies and Graphs
- Biodegradable Sensors
- 2-Way BMI (Brain Machine Interface)
- Health Passport
- Self-Supervised Learning
- Low-Cost Single-Board Computers at the Edge
- DNA Computing and Storage
- **AI-Assisted Design**
- Authenticated Provenance

Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity

Time

Plateau will be reached: ○ Less than 2 years   ● 2 to 5 years   ● 5 to 10 years   ● More than 10 years

1) A selection of emerging AI technologies highlighted in bold
Source: Gartner

> The **Gartner Hype Cycle**, developed and used by the American research, advisory and information technology company Gartner, provides a snapshot of the **maturity of innovations**

> It maps the speed at which each innovation is progressing through the Hype Cycle by indicating **how long** it will take **to reach the "Plateau of Productivity"** and the start of **mainstream adoption**

> The Gartner Hype Cycle characterizes the **typical progression of innovation**, from overenthusiasm through a period of disillusionment to an eventual understanding of the innovation's relevance and its role in a market or domain

Roland Berger

The progression of AI capabilities is expected to be near limitless – Intelligent machines will accomplish more and more ambitious tasks

Timeline of AI achieving human performance with a probability of 50%[1]

Telephone Banking Operator: Provide phone banking services as well as human operators can – without annoying customers more than humans

Answer Questions Without Definite Answers: Give good answers in natural language to factual questions posed in natural language for which there are no definite correct answers

Generate Top 40 Pop Song: Compose a song that is good enough to reach the US Top 40. The system should output the complete song as an audio file

Write New York Times Bestseller: Write a novel or short story good enough to make it to the New York Times bestseller list

2020 · **2024** · **2025** · **2026** · **2027** · **2028** · **2034** · **2049** · **2050**

One-shot Learning: See only one labeled image of a new object, and then be able to recognize the object in real world scenes, to the extent that a typical human can

Write a High School Essay: Write an essay for a high school history class that would receive high grades and pass plagiarism detectors

5 km Race in City: Beat the fastest human runners in a 5 kilometer race through city streets using a bipedal robot body

Go (same training as human): Defeat the best Go players, training only on as many games as the best Go players have played

AI experts expect that – with a probability of 50% – around **2060 unaided machines** will be able to **accomplish every task better and more cheaply than human workers**. Around **2140 all occupations** will be **fully automatable**[1]

Roland Berger

AI's huge power is met with enthusiasm mixed with concerns – Inherent human values must stay central to current and future developments

Selected views of entrepreneurs and scientists on AI

Greg Shannon, Carnegie Mellon University:
"If elements of community happiness are part of AI objective functions, then AI could catalyze an explosion of happiness."

Bill Gates, Microsoft Foundation:
"[The power of AI is] so incredible, it will change society in some very deep ways. The world hasn't had that many technologies that are both promising and dangerous."

Elon Musk, Tesla:
"Humans must merge with machines or become irrelevant in AI age."

Erik Brynjolfsson, MIT:
"We need to work aggressively to make sure technology matches our values."

Jeff Bezos, Amazon:
"I think autonomous weapons are extremely scary. [The artificial intelligence tech that] we already know and understand are perfectly adequate [to create these kinds of weapons]."

Concerns and solutions: AI and the future of humans – An expert survey by Pew Research 2018

Concerns

Human agency
Individuals are experiencing a loss of control over their lives

Data abuse
Data use and surveillance in complex systems is designed for profit or for exercising power

Job loss
The AI takeover of jobs will widen economic divides, leading to social upheaval

Dependence lock-in
Reduction of individuals' cognitive, social and survival skills

Mayhem
Autonomous weapons, cybercrime and weaponized information

Solutions

Global good is No. 1
Improve human collaboration across borders and stakeholder groups

Value-based system
Develop policies to assure AI will be directed at 'humanness' and common good

Prioritize people
Alter economic and political systems to better help humans 'race with the robots'

Sources: Pew Research; CNBC

Megatrend 6
Politics & Governance

The decline of democratic traits accelerates – Autocratization trends and democracy fatigue will pose challenges to global governance

Subtrends of megatrend "Politics & Governance"

1 Future of Democracy

2 Governance & Geopolitics

3 Global Risks

The future of (liberal) democracy is under threat – (Electoral) Autocratization trends have surged over the past decade

Autocratization – the decline of democratic traits – accelerates globally

Electoral autocracies — 67
Electoral democracies — 50
Liberal democracies — 37
Closed autocracies — 25
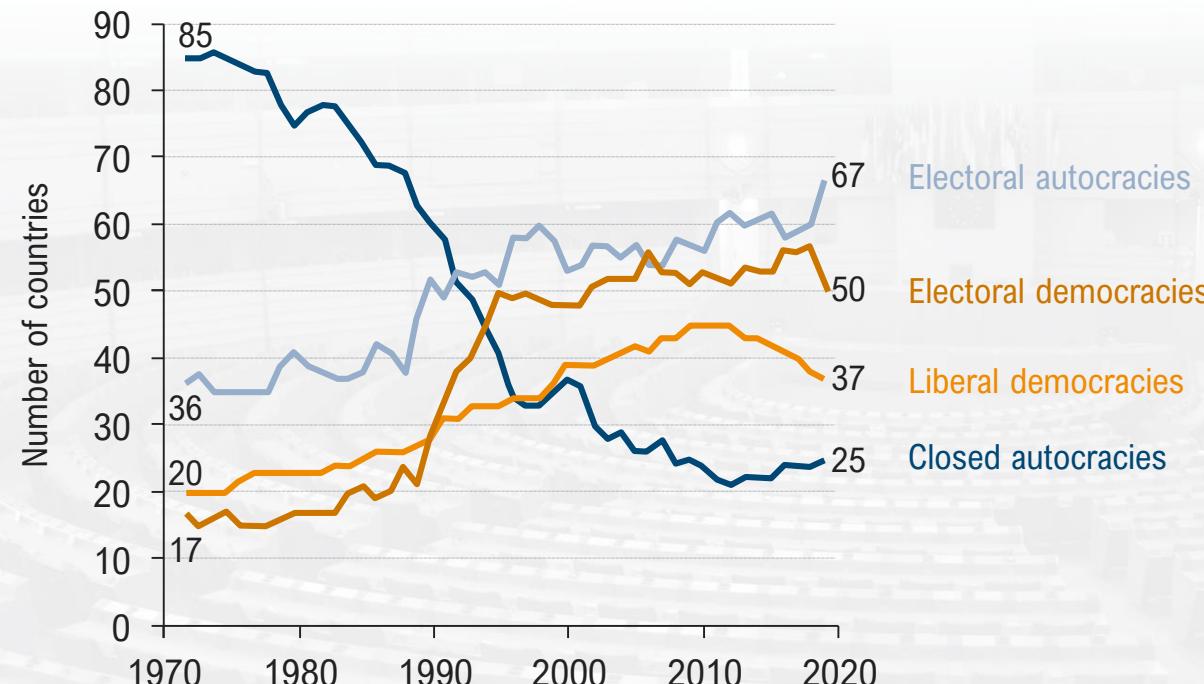
The University of Gothenburg varieties of democracies (V-DEM) dataset covers 470+ indicators for 200+ countries; according to V-DEM, **electoral democracies** are systems where a number of institutional features guarantee free and fair elections such as freedom of association and freedom of expression; **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

> For the first time since 2001, **autocracies** are in the majority: **92 countries** which are home to 54% of the global population, while **87 electoral and liberal democracies** comprise 46% of the world's population
> **Nationally**, this shift is exemplified by **Hungary**, now classified as the EU's first ever authoritarian regime member state; autocratization is affecting Brazil, India, Turkey, which are major populous economies with substantial military and political influence; **regionally,** Latin America is back on a level last recorded in the early 1990s, while Central Asia and Eastern Europe are at post-Soviet Union lows
> A notable trait of democracy, **freedom of expression**, has declined by the highest number of countries over the past decade: Attacks on freedom of expression and media freedom are **now affecting 31 countries**; the mass adoption of **social media** tools for the purpose of pro-democracy citizen protests – first seen during the Arab Spring a decade ago – has also given rise to abuse (e.g. dissemination of fake news or conspiracy theories) by national and foreign anti-democratic forces

Source: University of Gothenburg/V-DEM Institute

Within democracies, the public mood displays an unhappy trend – A rising level of dissatisfaction and democracy fatigue makes for a risky mix

Dissatisfaction with democracy 1996-2020 [%]

2005-2020: 18.8 pp. rise in dissatisfaction

57.5

47.9

38.7

1996   2005   2020

Across the globe, democracy appears to be in a state of malaise:

> **Dissatisfaction with democracy has risen over time** and is reaching an **all-time global high,** in particular **in developed countries**

> 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 has risen by almost one-fifth of the population (+18.8%)

> Looking more regionally, a notable **positive shift is seen in South East Asian democracies**, whereas Anglo-Saxon countries (North America, the UK, and Australasia) are less happy compared to the mid-1990s; Europe appears highly fragmented; at present, its 'democratic faith' contains some of the most uneven levels of dissatisfaction

> **377 million people** are living in democracies that face a genuine legitimacy **'crisis'.** These countries include Mexico, Brazil, Moldova, Colombia, Peru, Ukraine, and Venezuela

The Cambridge University'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 today. This represents 2.4 billion individuals across all continents

Source: University of Cambridge/Bennett Institute for Public Policy

Roland Berger

Looking ahead, the year 2024 is highly important for global governance and democracy – A world at crossroads

Parliamentary and/or presidential elections 2024

Europe	Americas & Oceania	Asia	Africa	Others
> Andorra > Austria > Belgium > Croatia > Finland > Georgia > Gibraltar > Iceland > Lithuania > Montenegro > North Macedonia > Romania > Russia > Slovakia > UK > Ukraine	> Dominican Republic > Dominica > El Salvador > Kiribati > Mexico > Palau > Panama > Uruguay > USA > Vanuatu > Venezuela	> Afghanistan > India > Indonesia > Iran > Jordan > Kazakhstan > Kuwait > Mongolia > South Korea > Sri Lanka > Syria > Taiwan > Turkmenistan > Uzbekistan	> Algeria > Botswana > Comoros > Egypt > Ethiopia > Ghana > Madagascar > Mauritania > Namibia > Rwanda > Senegal > South Africa > Tunisia	> EU Parliamentary elections > UN Security Council Elections

> Globally, US President Elect Biden's four year term in office – starting officially in 2021 – is seen as a signal but more so a time under scrutiny, with the view to a **possible re-set** of a more **multilateral global engagement**, with values more aligned with **Western liberal democratic norms and values**: reason, right, and tolerance. What can be achieved by the new US government – and potentially even be carried forward into a second term in office in 2024 – remains to be seen

> Thus, the longer term test still lies ahead: **2024** – an already **important year for the US but also a worldwide mammoth election year**, where an unprecedented number of countries and blocs – ranging across the entire spectrum of electoral systems, from liberal democracies to autocracies – head to parliamentary and/or presidential ballot boxes

> Countries and economic blocs of **considerable global power** include USA, Russia, India, the EU etc., while a high number of regionally important countries will decide if their respective national **political pendulum** swings towards a more democratic governance style – or not

Source: Roland Berger

Roland Berger

The future of global governance appears to be in a state of flux – The international powerplay is shaped by geopolitical alliances and rivalries

Four possible futures for global governance

Powerful states

Competition / **Cooperation**

Diffusion of power

Multipolarity
> Major powers are the main actors within blocs of close or like-minded states
> Lead by the major power, cooperation exists within the bloc, while blocs compete for power and influence against each other
> Intense competition leads to instability, resource inequalities and multilateral institutions becoming ineffective
> Emerging powers target vulnerabilities to enhance their position
> Challenging the 'rule book' triggers conflicts and crises; democratic traits are under pressure

Multilateralism
> States are the most influential actors in the global order using multilateral institutions to cooperate and to reduce global instability
> Current norms and international institutions are likely to be reformed through effective processes in order to accommodate the interests of new powers and to address global challenges
> Strong, effective state institutions have the capacity to address political, societal, and environmental issues
> Governments are able to provide acceptable levels of support and welfare

Fragmentation
> Global governance is almost impossible: States, corporations, megacities and other non-state actors compete for power in a volatile environment
> Cooperation is rare, unreliable and only self-serving
> States cannot provide services, this area is exploited by non-state actors
> Due to lack of regulation and protection, inequality and lawlessness rise
> The social contract between the state and its people is eroded, causing high levels of uncertainty and insecurity

Network of actors
> Power is shared between a variety of state and non-state actors, both globally and domestically
> All actors cooperate to address global challenges under an effective hybrid form of governance, reducing the risk of conflict
> Corporations and leaders of megacities are the main players
> Non-state actors deliver important and essential services
> Private services are not affordable for many
> Societal cohesion is reduced due to inequality of access and opportunities

Sources: UK Government/Ministry of Defence; Roland Berger

Roland Berger

Today's leaders face a diverse range of global risks now and in the decade ahead …

Top 10 global risks over the next 10 years

Long-term risk outlook: Likelihood

Extreme weather · Climate action failure · Human environmental damage · Infectious diseases · Biodiversity loss · Digital power concentration* · Digital inequality* · Interstate relations fracture* · Cybersecurity failure · Livelihood crises
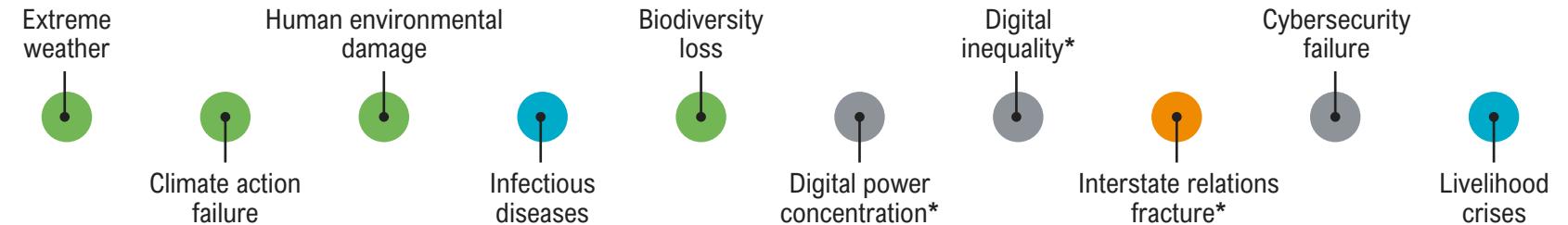
Long-term risk outlook: Impact

Infectious diseases · Climate action failure · Weapons of mass destruction · Biodiversity loss · Natural resource crisis · Human environmental damage · Livelihood crises · Extreme weather · Debt crises · IT infrastructure breakdown
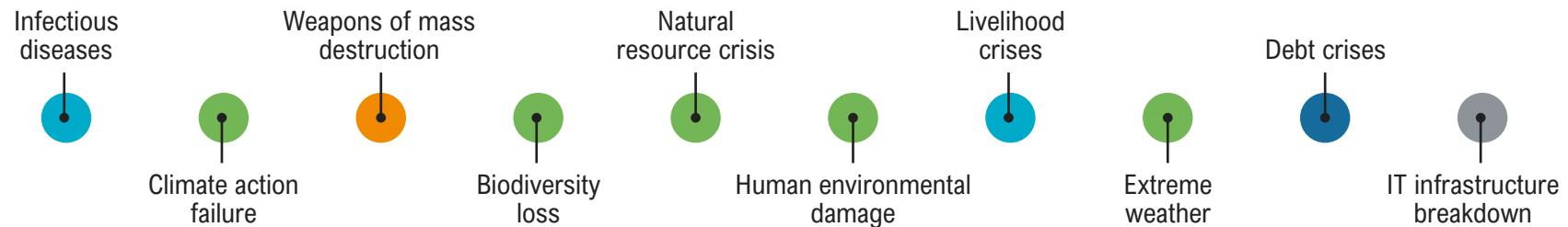
> The World Economic Forum's Global Risks Report is based on its annual Global Risks Perception Survey, completed by more than **800 members** from the WEF's extensive network of business, government, civil society, and thought leaders. Input for the 2021 report was sought in the fall of 2020, **during the COVID-19 pandemic**. The WEF defines **global risk** as an "**uncertain event or condition** that, if it occurs, can cause **significant negative impact** for several countries or industries within the next 10 years" – denoting a longer-term perspective

> Amongst the WEF Global Risks 2021 assessment, **infectious diseases** risks are – unsurprisingly – at the forefront of members surveyed, top in terms of impact but also in the top 5 in terms of likelihood – the latter pointing perhaps to future concerns of repeat or similar health crises

> Notable this year, **technological risks** are more visible than for some time in the top 10; especially **risks relating to digitalization** appear to simmer just below the top 5 risk surface in terms of likelihood and include **two out of 12 new risks (*)** included in the survey this year; equally topical, ongoing major rivalries between political powers have also left their mark in a new risk **(fracture of interstate relations)** joining the top ranks

● Economic ● Environmental ● Geopolitical ● Societal ● Technological

Sources: WEF; Roland Berger

Roland Berger

… while historically and across all categories, risk awareness has broadly shifted from the economy to the environment

Top 5 risk categories by likelihood and impact, 2007-2021

Likelihood

Impact

2007   2021
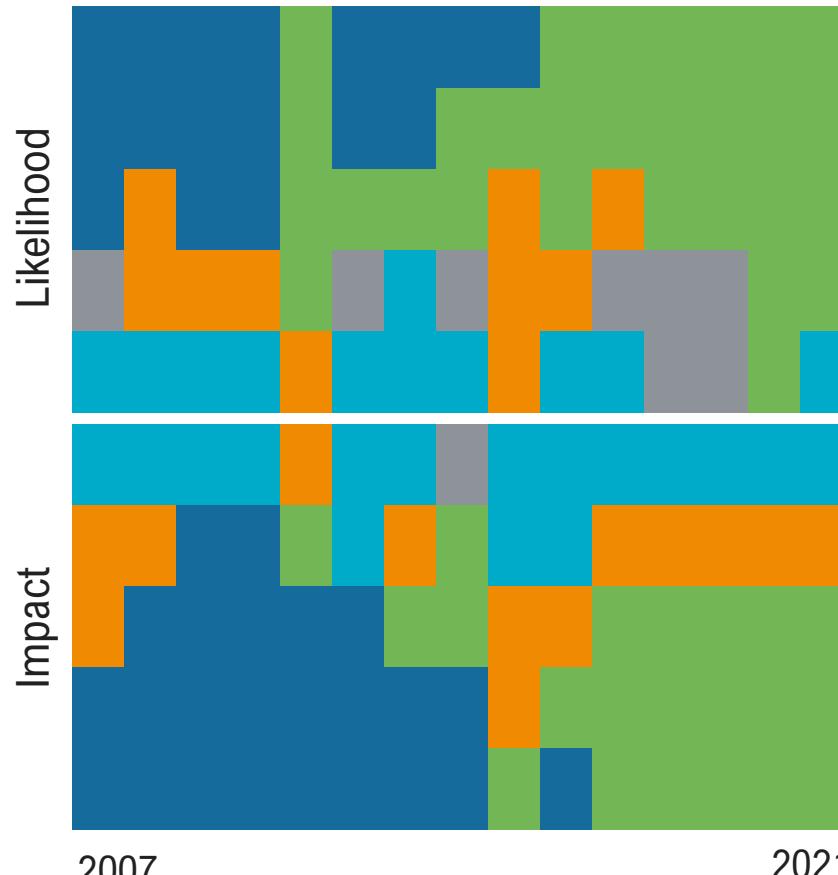
Global risks surveyed 2021

● **Economic**

> Asset bubble burst in large economies
> Collapse of a systemically important industry[1]
> Debt crises in large economies
> Failure to stabilize price trajectories
> Proliferation of illicit economic activity
> Prolonged economic stagnation[1]
> Severe commodity shocks

● **Environmental**

> Biodiversity loss and ecosystem collapse
> Climate action failure
> Extreme weather events
> Human-made environmental damage
> Natural resource crises

● **Societal**

> Collapse or lack of social security systems[1]
> Employment and livelihood crises
> Erosion of social cohesion
> Failure of public infrastructure
> Infectious diseases
> Large-scale involuntary migration
> Pervasive backlash against science[1]
> Severe mental health deterioration[1]
> Widespread youth disillusionment[1]

● **Geopolitical**

> Collapse of a multi-lateral institution[1]
> Fracture of interstate relations[1]
> Geopolitization of strategic resources[1]
> Interstate conflict
> State collapse
> Terrorist attacks
> Weapons of mass destruction

● **Technological**

> Adverse outcomes of technological advances
> Breakdown of critical information infrastructure
> Digital inequality[1]
> Digital power concentration[1]
> Failure of cybersecurity measures
> Failure of technology governance[1]

1) Denotes new risk

Source: WEF; Roland Berger

Roland Berger

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

Roland Berger

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Roland Berger