Roland Berger Trend Compendium 2030

Megatrend 4
Climate change & ecosystem at risk

October 2017

About the Roland Berger Trend Compendium 2030

What is it?

> The Roland Berger Trend Compendium 2030 is a global trend study compiled by Roland Berger Institute (RBI), the think tank of Roland Berger

> It describes the most important megatrends that will shape the world between now and 2030

> The megatrends have a broad impact on the environment of companies, strongly influencing challenges and opportunities of their business

Our approach

> We first screened relevant trend, scenario and future studies worldwide

> Then we verified, analyzed and consolidated the results, using them to define the megatrends

> Next, we broke down the megatrends into subtrends, looking at each from a global perspective and the viewpoints of industrialized and developing countries

> Finally, we identified corporate actions that companies worldwide should consider taking today

Use it!

> For your own presentations, for discussions with clients and business partners or as springboards for acquisition approaches

> Following the description of the subtrends and the recommended corporate actions, you will find the most important sources to help you keep track of the changes in the world, as well as dig deeper into the trends presented

The Roland Berger Trend Compendium 2030 focuses on stable long term developments

> The Roland Berger Trend Compendium covers megatrends – long-term developments with major impact (usually global) on companies, economies and the natural world

> The forecasts are based on estimates reflecting the "normal" case, i.e. a stable development of the global economy with no unexpected events ("black swans"). Major political or financial crises, large-scale natural disasters or similar far-reaching events are not integral to our assumptions

> To incorporate today's volatile, uncertain, complex and ambiguous (VUCA) environment into strategic planning we recommend to combine the megatrends of the Roland Berger Trend Compendium with the Roland Berger scenario planning approach

Methodology

It covers seven megatrends that shape the future development of our world

1. Demographic dynamics
2. Globalization & future markets
3. Scarcity of resources
4. Climate change & ecosystem at risk
5. Dynamic technology & innovation
6. Global knowledge society
7. Sustainability & global responsibility

Megatrends

Interdependences of climate change and ecosystem trends make global answers necessary – There are three key subtrends

Subtrends of megatrend "Climate change & ecosystem at risk"

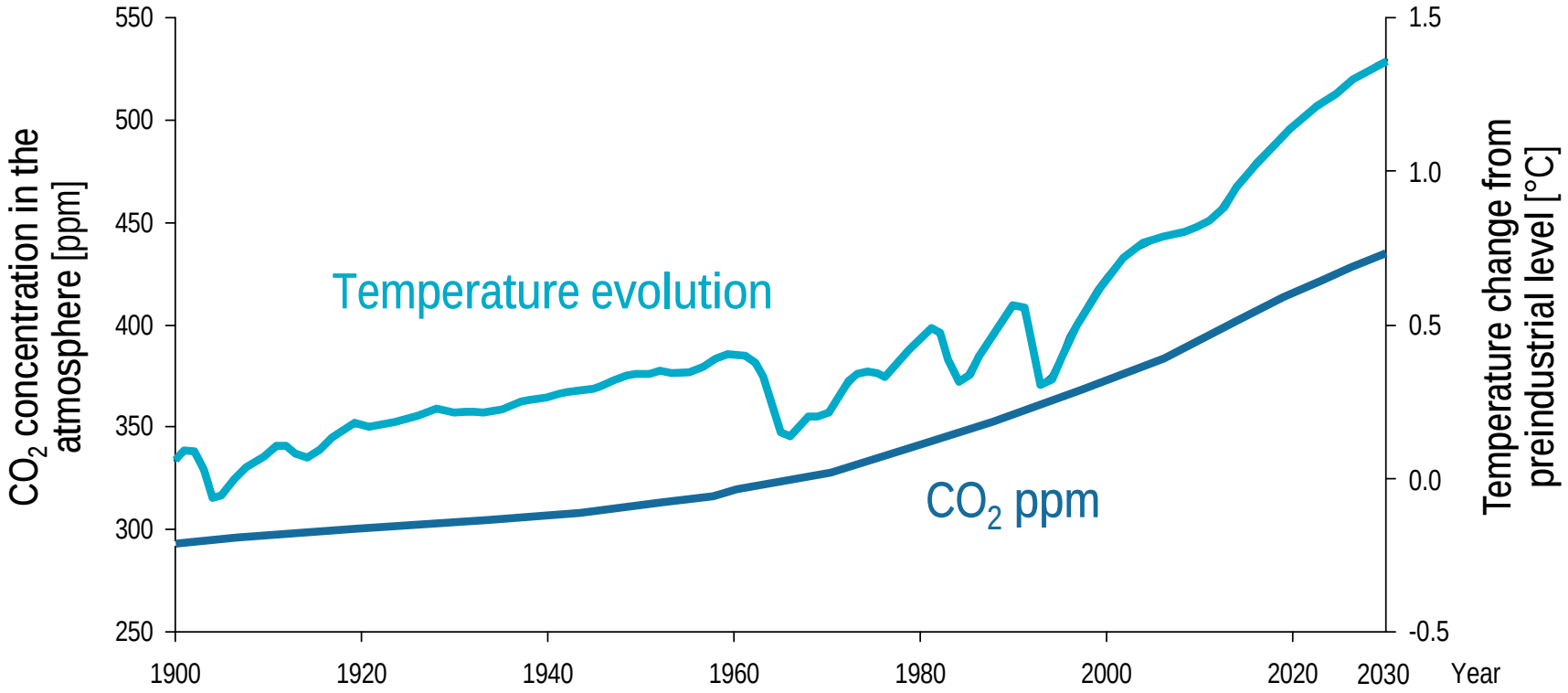
Global warming – The core of climate change

Rising CO_2 emissions – Non-OECD as accelerant

Ecosystem at risk – Threatened basis of life

Our earth is getting warmer and warmer – The rise in temperature is strongly correlated with increasing CO_2 emissions

Evolution of CO_2 concentration and global temperature 1900-2030, forecast according to the IPCC "business as usual" scenario[1)]



1) CO2 ppm and temperature assumptions following IPCC A1FI scenario as business as usual scenario

Source: C-ROADS, IPCC

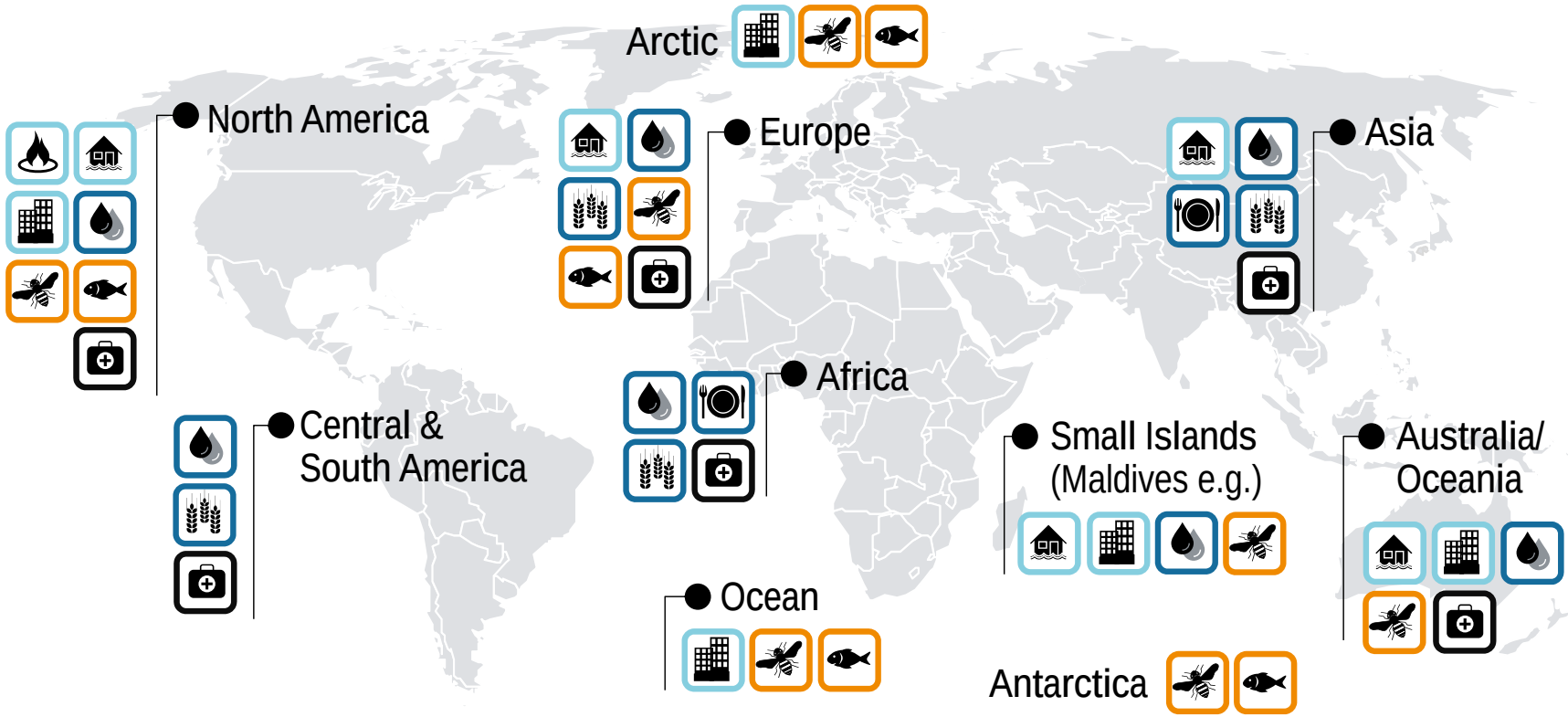
Due to slow removal of atmospheric CO_2 global warming cannot be halted in the short term, causing severe longer term consequences

- CO_2 emissions and temperature rise are strongly correlated. There is a wide scientific consensus that the global climate is changing and that human activity contributes significantly to this trend. The IPCC concludes with 95% certainty that the human influence on the climate system is clear and is caused by increasing greenhouse gas emissions
- The slow removal process of CO_2 and other greenhouse gases in the atmosphere causes an accelerating effect on warming expected to last till 2100 and leads to a temperature increase even when aggressive mitigation strategies are implemented. For stabilizing the temperature rise at 2°C compared to the pre-industrial level (within a temperature increase of 2°C the effects of climate change are expected to be manageable) after 2050, the total CO_2 emissions need to be cut down by approx. 20% until 2030 compared to the 2013 level
- Increasing global temperatures lead to rising sea levels. There are three major reasons for a sea level rise: Firstly and strongest, melting polar caps and the melting ice sheet of Greenland. Secondly, atmospheric warming causes water warming, resulting in thermal expansion of the sea. Thirdly, water from melting glaciers flows directly, or via rivers, into the sea
- Even with relatively minor average temperature and sea level increases, the nature, frequency and intensity of extreme weather events, such as tropical cyclones (including hurricanes and typhoons), floods, droughts and heavy precipitation, are expected to rise

Source: IPCC, IEA, EIA

Global warming affects the entire world, but regional impacts differ

Important impacts of climate change in different world regions



Natural disasters:
- Wildfire
- Flood damages
- Loss of coastal infrastructure, settlements, natural habitats

Scarcity of resources:
- Scarcity of fresh water
- Food scarcity
- Low crop yields

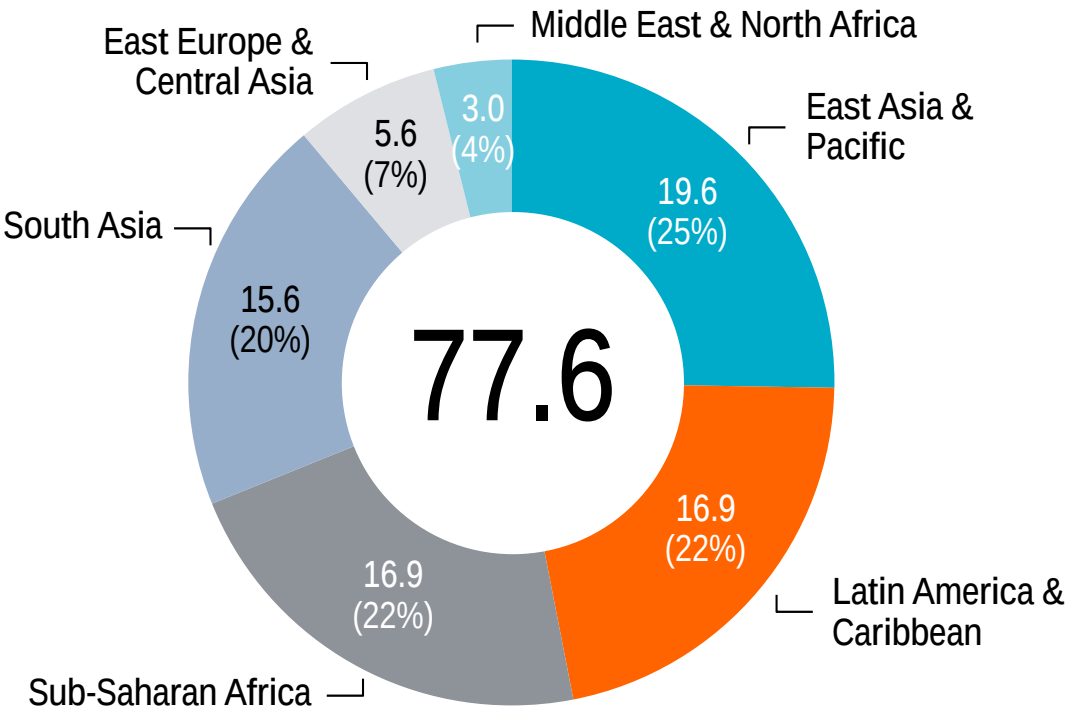
Impact on species:
- Extinction of species
- Change of species appearance (concerning fishery e.g.)

Impact on health:
- Health problems (due to heat 6 diseases)

Source: IPCC, AFP, BZ

The financial impact of climate change for developing countries is high – Poorest regions feel biggest ramifications in GDP terms

Annual cost of adapting to climate change[1)] for developing countries and regional share 2010-2050 [USD bn]



Conclusions

> **Developing countries** in Asia, Latin America and the Sub-Saharan region **face the largest share of financial impacts of climate change**. In total, Asia accounts for 45% of all predicted annual payments by developing countries. Latin America & Caribbean and the Sub-Saharan countries stand for 22% each

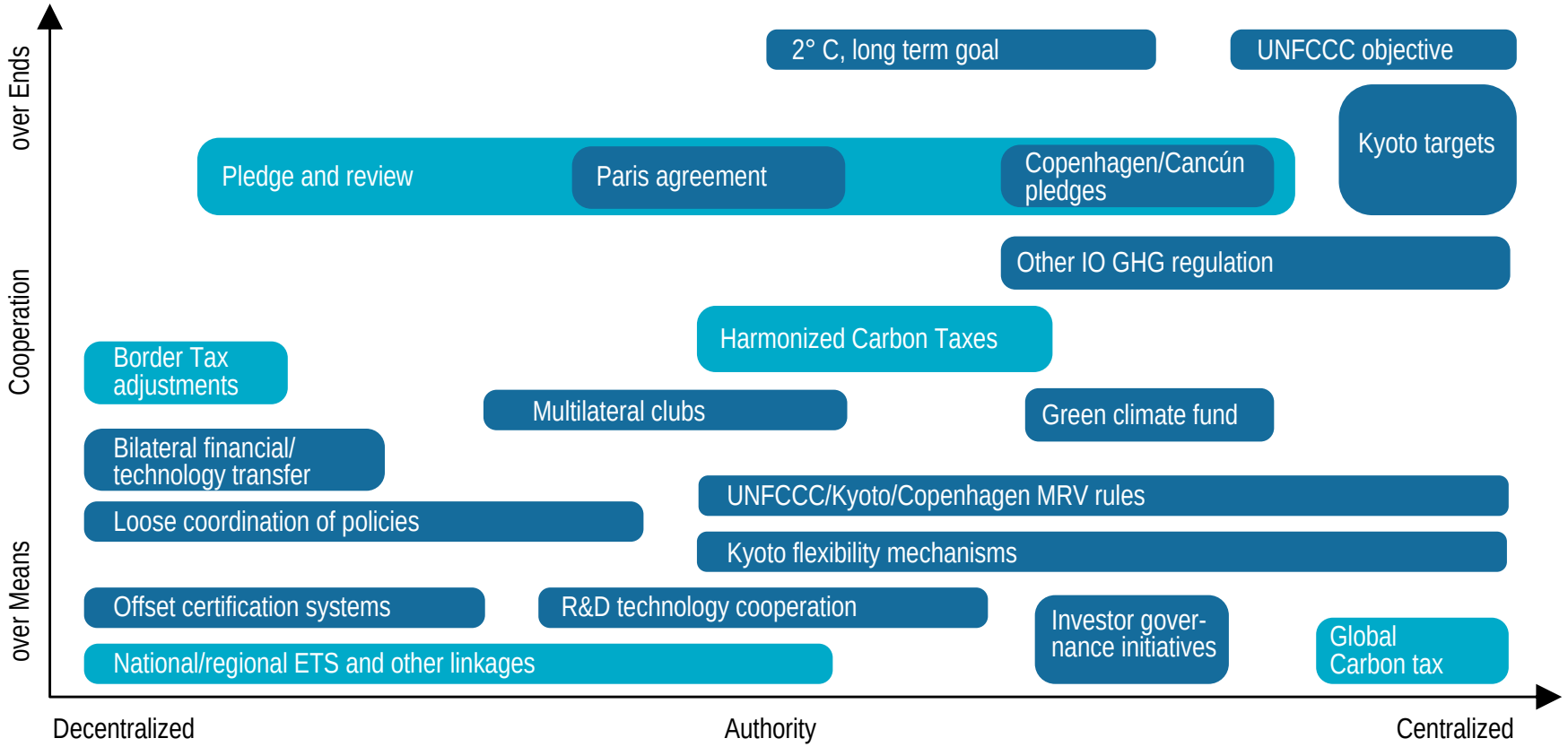
> Regarding the **relation of cost to respective GDP, the Sub-Saharan** region shows **highest payments with around 0.5% of GDP** on average. Latin America & Caribbean face approx. 0.22% of GDP as cost. East Europe & Central Asia, South Asia and East Asia face an average GDP cost of around 0.1-0.14% till 2050, and Middle East & North Africa around 0.08%

1) Linear extrapolation of costs. Adaption includes planned, public policy costs, such as infrastructure programs and other costs to strengthen climate change resilience. A temperature rise of around 2°C by 2050 is taken as basis for calculations

Source: World Bank

To fight climate change is a global challenge – Many cooperation arrangements exist, but efforts must be significantly increased

Forms of cooperation to fight climate change



Existing arrangements Proposed arrangements

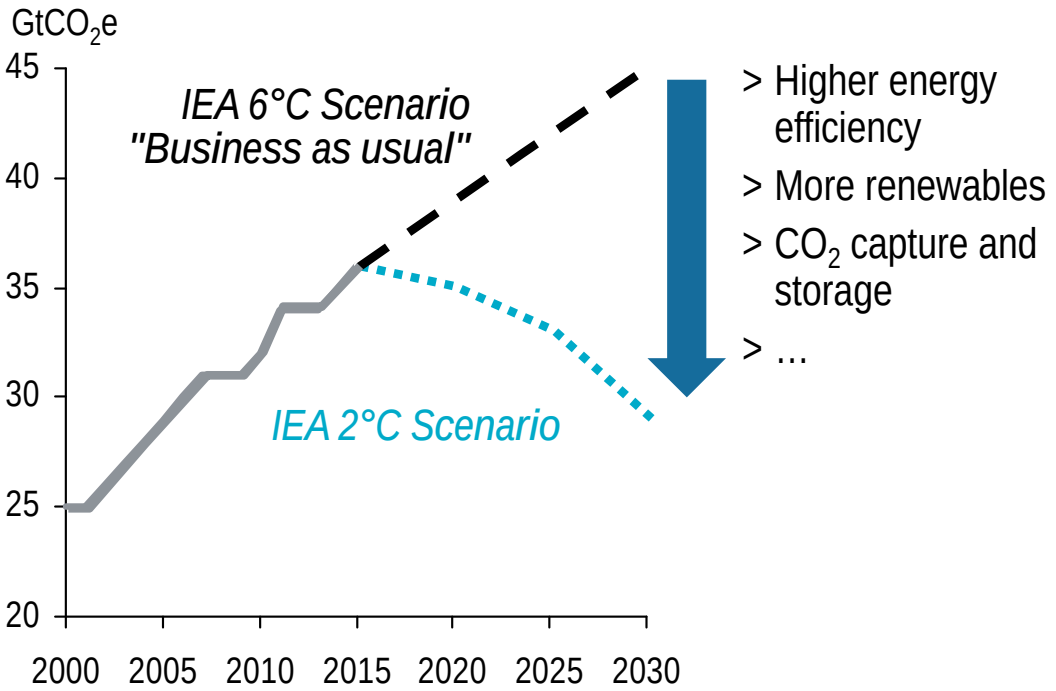
Note: UNFCCC = United Nations Framework Convention on Climate Change IO = International Organization GHG = Greenhouse Gas MRV = Measurable, Reportable, Verifiable ETS = Emission Trading Scheme

Source: IPCC

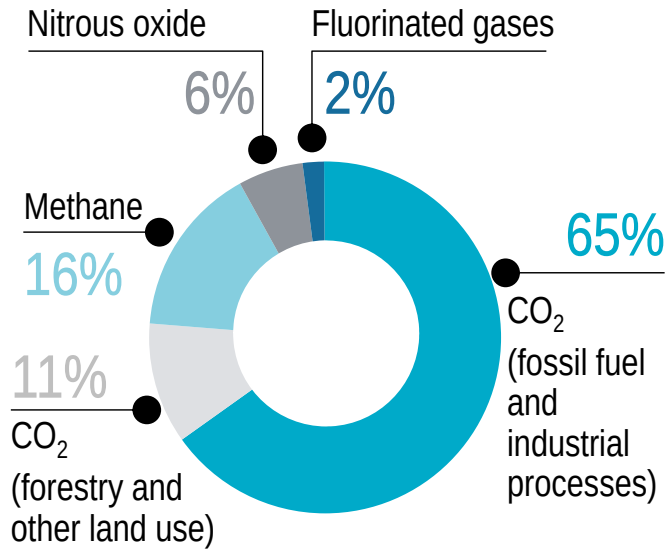
Limiting global warming requires measures to reduce emissions of greenhouse gases – CO_2 being the most significant

Global CO_2 emissions under different scenarios[1)] and composition of global green house gas (GHG) emissions[2)]

Global CO_2 emissions under different scenarios



Composition of GHG emissions



Global GHG emissions 2013: 54 $GtCO_2e$

Note: $GtCO_2e$ = Gigatonnes CO_2 equivalent 1) CO_2 emissions from fuel combustion and industrial processing. 6°C and 2°C scenarios according to IEA describing different global warming scenarios, referring to average global temperature rise above pre-industrial levels by 2100 2) Split of GHG emissions refers to 2010 data from the IPCC 2014 report

Source: IEA, EIA, IPCC

The main lever to reduce greenhouse gases and thus global warming is the reduction of CO_2 from fuel combustion

> **Increasing concentrations of greenhouse gases** (GHG) have been the **main driver of rising temperatures** since the beginning of the 20th century. The main GHG that can be directly influenced by humans in the earth's atmosphere are CO_2, (more than 3/4th of total GHG emissions), methane, nitrous oxide and ozone. As **anthropogenic emissions of CO_2** result primarily **from the combustion of fossil fuels**, energy consumption is at the center of the climate change debate. About half of the anthropogenic CO_2 emissions between 1750 and today have occurred in the last 40 years

> The concentration of CO_2 in the earth's atmosphere is approximately 402 ppm (parts per million) by volume as of October 2016. This is about **44% higher than the atmospheric CO_2 levels** before the Industrial Revolution in the 1750s (280 ppm). Because of slow removal processes, atmospheric CO_2 will **continue to increase** even if emissions are substantially reduced from their present levels. Ocean acidity is on a 300 million years high, as since the beginning of the industrial era, human activity has added 4 kg of carbon dioxide per day per person on average to the ocean

> **Without further mitigation efforts** with regards to total GHG emissions, the concentration of GHG in the earth's atmosphere will rise up to **450-500 ppm towards 2030** and will be at 750-1,300 ppm in 2100. The Intergovernmental Panel on Climate Change (IPCC) states that a level of about **450 ppm in 2100 is needed to reach the 2°C goal**

> CO_2 aside, **methane accounts for the second biggest share of GHG emissions** (16% in 2010, measured in CO_2 equivalents). Methane is emitted by natural sources such as wetlands, as well as human activities such as leakage from natural gas systems and the raising of livestock. Methane's lifetime in the atmosphere is much shorter than CO_2's, but comparing same masses methane traps over 25 times more heat from the sun radiation than CO_2. Over the past ten years **methane emissions have risen unexpectedly** ten times faster than from 2000 to 2006 and therefore could jeopardize the 2°C climate target. The reason for this phenomenon is unclear, the strong increase could come from additional emissions from agricultural sources, mainly around the tropics, but further research is necessary

Source: IPCC, EPA, WMO, national geograhic, environmental research letters

Latest developments indicated growing international commitment to reduce CO_2 emissions – However Trump brings uncertainty

> As future CO_2 emissions highly depend on political commitment and actions the IEA developed **different scenarios concerning future CO_2 emissions**. According to the **"Business as usual"** scenario, global temperature will increase by 5.5°C in the long term and almost 4°C by the end of this century compared to the pre-industrial level. Thus CO_2 emissions in 2030 would be **45 Gt** (+25% compared to 2015). To go for the ambitious scenario with a temperature **increase of only 2°C** in the long term compared to the pre-industrial level (with a temperature increase of 2°C the effects of climate change are expected to be manageable), CO_2 emissions need to be **reduced by nearly 20% to 29 Gt in 2030** and 15 Gt in 2050

> Latest developments show a **growing international commitment** to reduce CO_2 emissions. The **Paris Agreement**, negotiated at the 21st UN Climate Change Conference in November and December 2015, went into effect in November 2016. More than 190 countries committed to reduce and report their greenhouse gas emissions with the goal of keeping global temperature rise from pre-industrial levels **well below 2°C by 2100** and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial level. Also in November 2016 the 22nd UN Climate Change Conference was held in **Marrakesh.** Nearly 50 countries from Africa, Asia and the Caribbean, which are particularly hit by climate change (such as the Philippines, Bangladesh or Pakistan), announced to **get out of coal, oil and gas** and convert their energy supply to renewables by 2050 the latest to reach the common goal of limiting global warming to 1.5°C

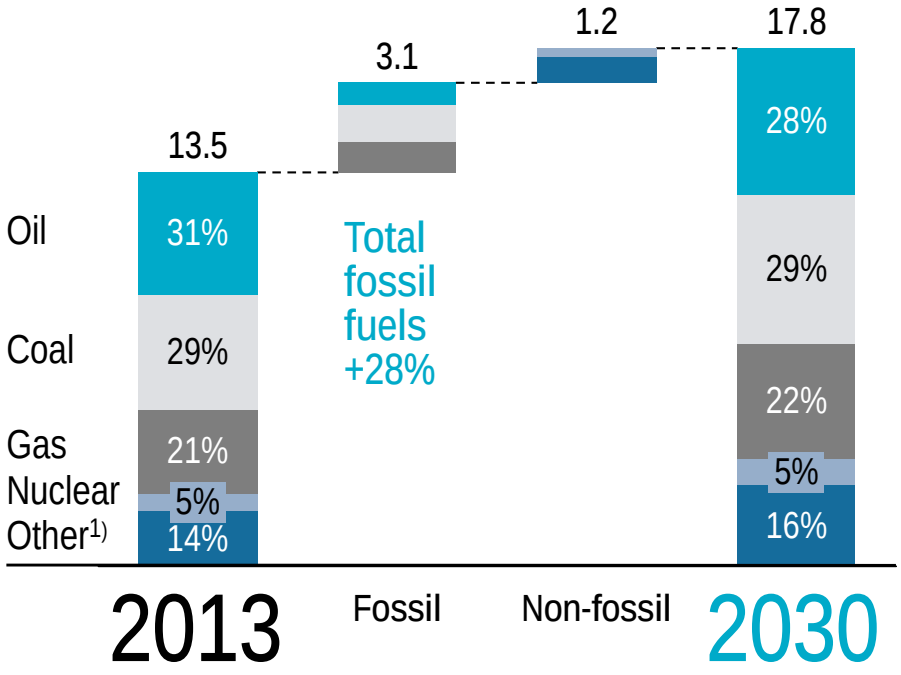
> However with the election of **Donald Trump as US president** – the US being the second-largest emitter of CO_2 emissions after China – **global climate goals could face a derailment**. During the election period, Trump declared his intentions to **end the US participation in the Paris climate agreement**. In a 2016 strategy paper, "New Deal for Black America", Trump promises a sum of USD 100 billion in savings over eight years by **eliminating investment in climate protection**. Subsequently, in his "An America First Energy Plan", he states a **focus on coal, oil and gas** – cancelling his predecessor's Climate Action Plan

Source: IEA, GEO, Spiegel, BBC, White House

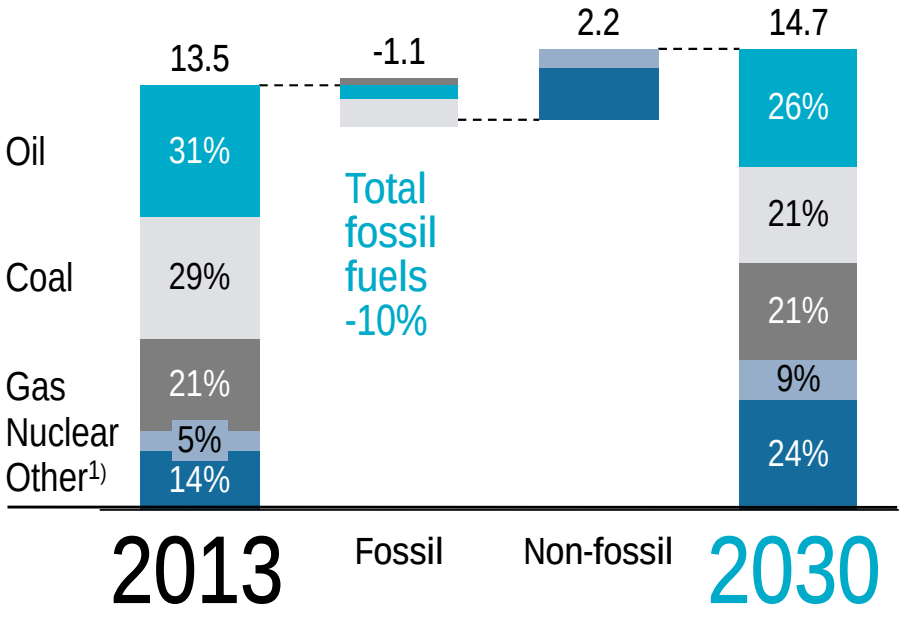
To lower CO_2 emissions from fuel combustion the use of fossil fuels must be reduced – As indicated in the IEA 2°C scenario

Fuel mix of global energy demand in the IEA 6°C and 2°C scenarios [Gtoe]

6°C Scenario



2°C Scenario

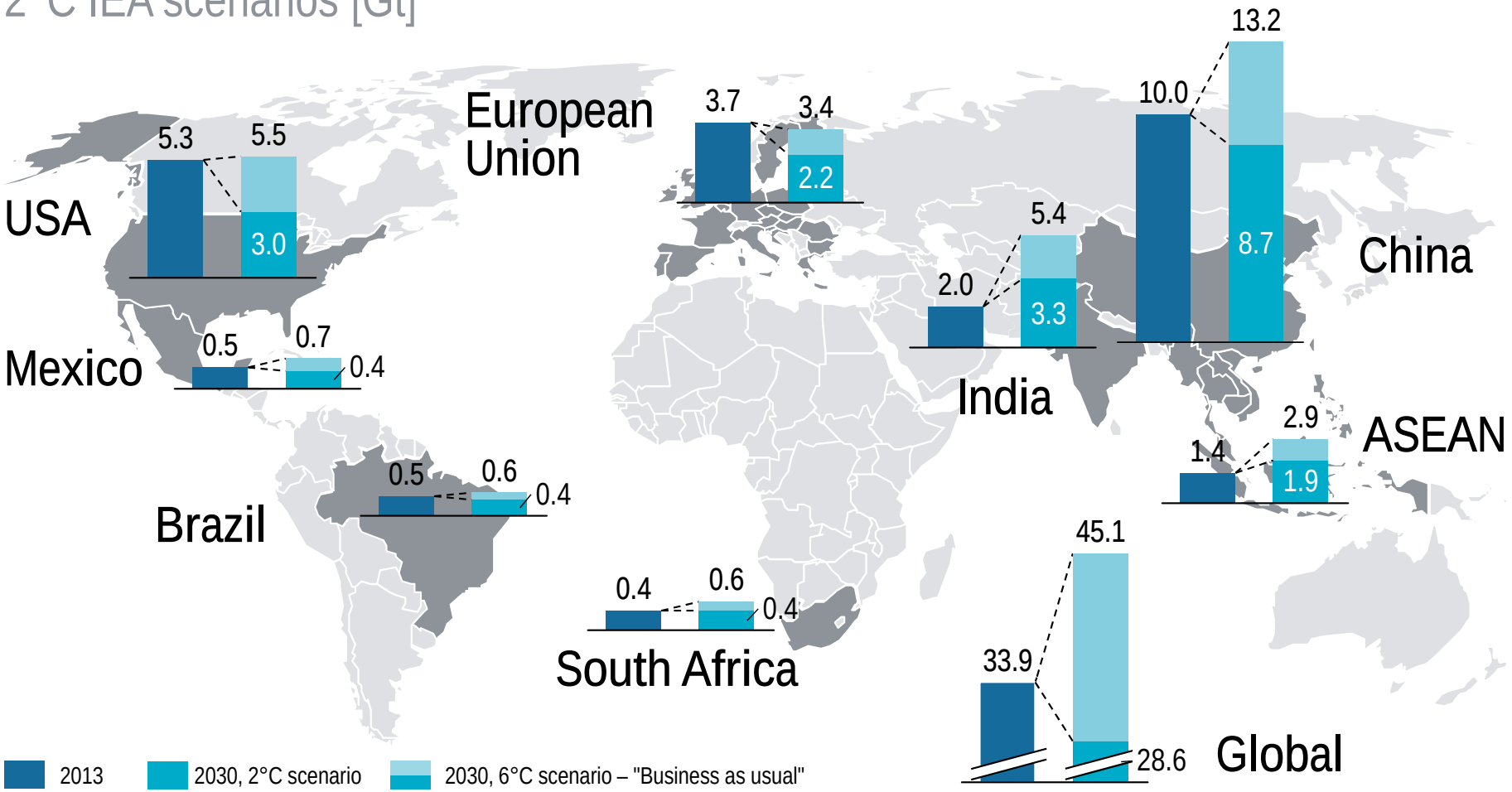


Note: Gtoe = Gigatonnes of oil equivalent 1) Other: Biomass/waste, hydro, geothermal, solar, wind

Source: IEA

Crunch regions Asia and North America: Future CO_2 emissions highly depend on actions being taken by China, India and the USA

Total CO_2 emissions in selected regions 2013 and 2030 according to the 6°C and the 2°C IEA scenarios [Gt]



Note: Gt = Gigatonnes

Source: IEA

China, the USA and India account for 50% of global CO_2 emissions and 50% of the saving potential by 2030 – E.g. reduction of coal

> To reduce greenhouse gases and thus temperature increase the reduction of CO_2 **emissions from fuel combustion** is a main lever. According to the IEA **2°C scenario** CO_2 **emissions from fuel combustion will increase only 8% between 2013 and 2030** to 14.7 Gtoe compared to **31% in the business as usual scenario**. The **share of fossil fuels must be reduced** to reach the goals of the 2°C scenario (long-term temperature rise of 2°C compared to preindustrial levels)

> Thus in the IEA 2°C scenario **the global share of fossil fuels will be reduced to 67% by 2030**, coming from 81% today. The share of **coal** will be **decreased by 8.1%-points** to 21%, the share of **oil by 5.5%-points** (2°C scenario) between 2013 and 2030. Coal is the most carbon-intensive fossil-fuel. However, the ExxonMobil Outlook for Energy 2017 study, predicts that the share of coal will still be 23% in 2030. Looking at the latest commitment of several countries in Marrakesh to get out of coal and focus on renewable energy sources, an optimistic forecast seems quite realistic

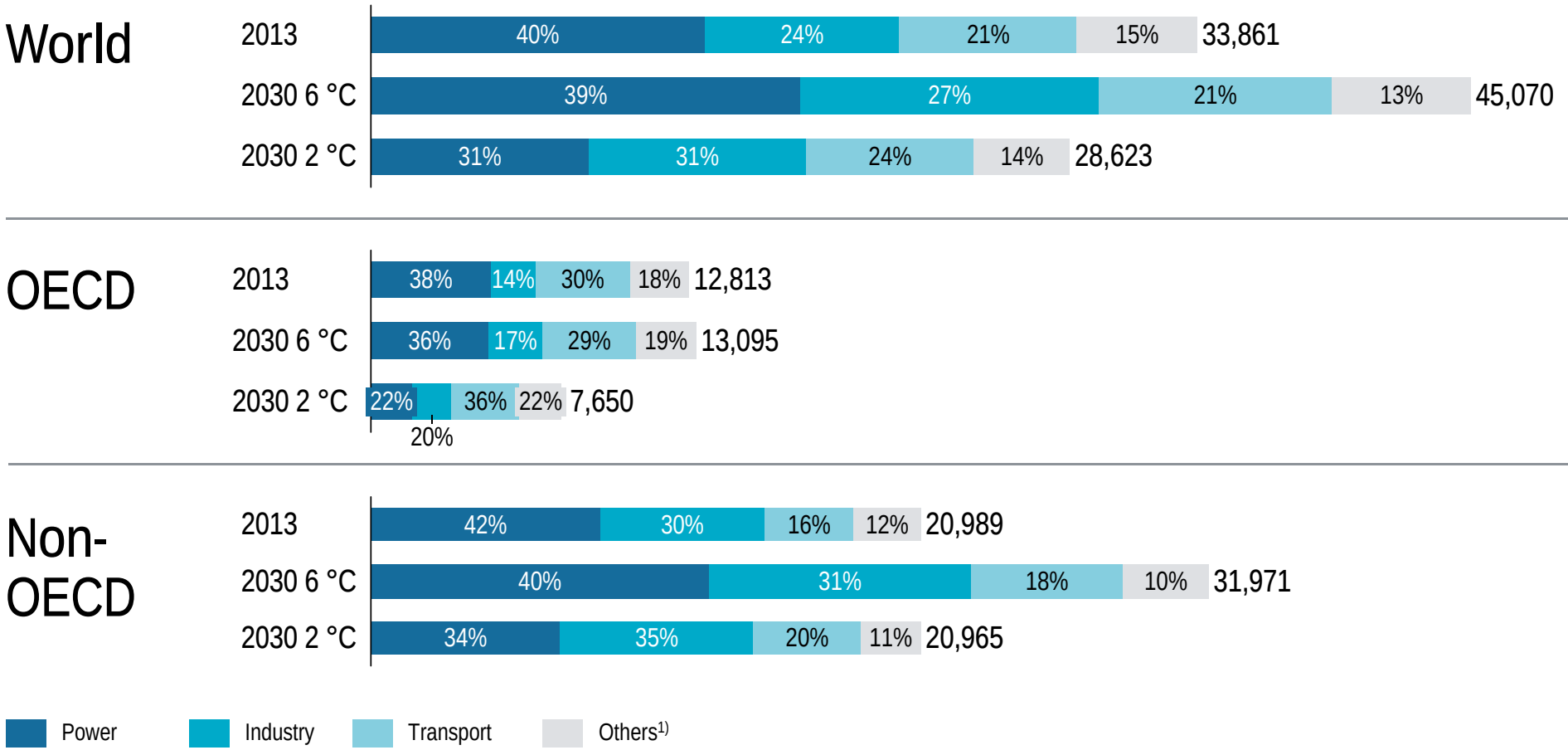
> Concerning the **impact of certain countries** to the climate change, **China, India and the US play a major part**. The three countries together account for **more than half of global CO_2 emissions** today (China 29.5%, the USA 15.6% and India 5.9%) and in 2030. China's share stays relatively stable to 2030, while India's share will rise to nearly 12% while that of the USA is reduced to 12.2% or 10.6% for the 6°C or 2°C scenario respectively. **India** shows the **strongest relative growth** with +119% by 2030 if things remain unchanged or +36% within the 2°C scenario

> If **China** does business as usual, its annual CO_2 emissions would increase by 3.2 Gt in 2030 compared to 2013, which is about the size of the EU emissions in 2030 for the business as usual scenario or the amount of the USA in 2030 under the 2°C scenario. **India's CO_2 "saving potential"** between the two scenarios in 2030 is about **2 Gt** and that of the **USA even 2.5 Gt**, which is comparable with the **total EU emissions in 2030 under the 2°C scenario**

Source: IEA, ExxonMobil

Regionally, non-OECD countries hold the greatest potential to reduce future CO_2 emissions – By sector, power production is key

Direct CO_2 emissions split up 2013 and 2030 IEA 6°C vs. 2°C scenarios [Mt CO_2]



Note: Mt = million tonnes 1) Others: Other transformations (covers non-specified transformation not shown elsewhere, such as the transformation of primary solid biomass into charcoal), buildings, agriculture, fishing, non-specified other

Source: IEA

Reducing CO_2 emissions to reach the 2°C scenario would only require a financial effort of about 0.1% of global GDP

> **Non-OECD countries play a major role** in future CO_2 emissions. In 2013, they already accounted for two third of global CO_2 emissions, raising their share by 2030. In the IEA business as usual scenario they would account for **71% of global CO_2 emissions in 2030 and even 73% in the 2°C scenario**

> With regard to **different sectors**, **power generation** causes the **greatest share of CO_2 emissions today** (40% in 2013). However as the power sector holds great potential to reduce CO_2 emissions, its share can be decreased by 9%-points to 31% in 2030 under the IEA 2°C scenario

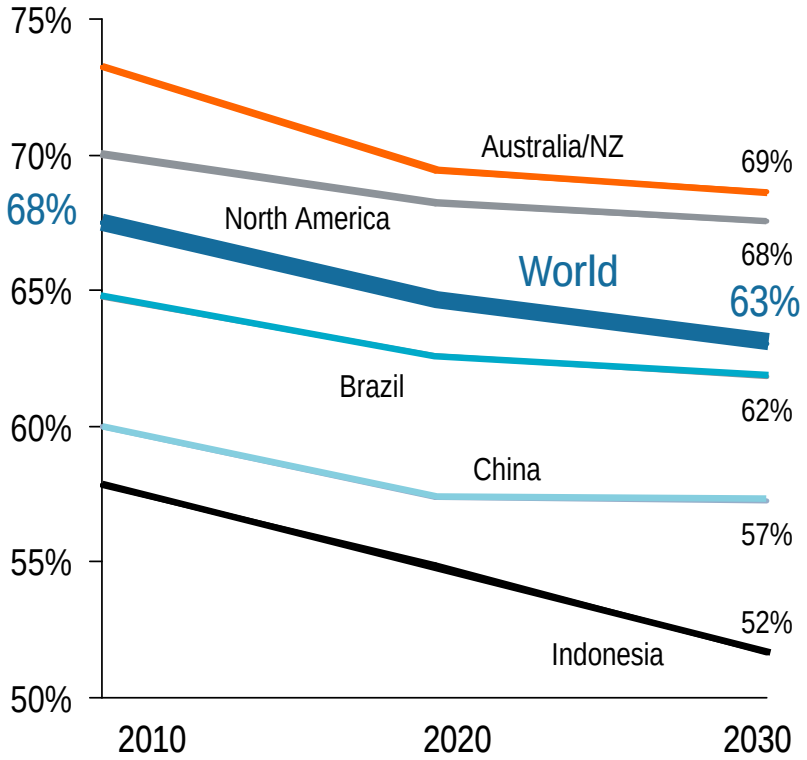
> The **second largest sector is industry**, which accounted for 24% in 2013 and will increase to 27% or 31% in the 6°C vs. the 2°C scenario. In absolute terms, its CO_2 emissions in 2030 in the 2°C scenario will be about the same as today

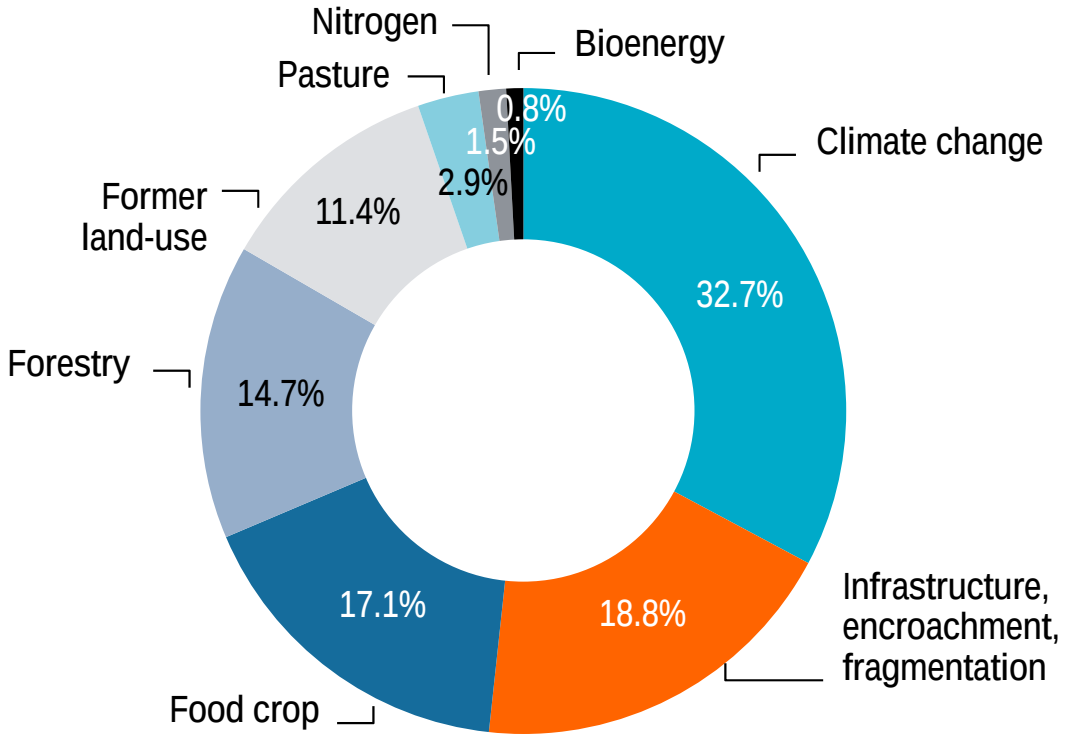
> According to the IEA, **investment costs** to reach the 2°C scenario would not require unreasonable additional financial efforts from the global economy. Decarbonizing the power sector in the 2°C scenario would cost about **USD 9 trillion between 2016 and 2050**, which is equivalent to **0.1% of the cumulative global GDP** over the same period. Achieving the potential energy savings of the end-use sectors (buildings, industry and transport) sectors would entail combined additional investment costs of **USD 3 trillion** between 2016 and 2050

Source: IEA

The worldwide potential of biodiversity is declining – Anthropogenic factors account for pressure

Evolution of terrestrial biodiversity and main pressures on terrestrial biodiversity 2010-2030[1)]





1) Terrestrial biodiversity (figure on left side) is measured in terrestrial mean species abundance (terrestrial MSA), which is a relative indicator describing changes of biodiversity with reference to the original state of the intact or pristine ecosystem (i.e. a completely intact ecosystem has a MSA of 100%). The figure on the right side shows the relative share of different kinds of pressure to terrestrial MSA during the period 2010-2030

Source: OECD

Compared to the past, climate change gains significance in affecting terrestrial biodiversity

> The **conversion and destruction of land** will continue over the next 20 years. With a **business as usual scenario**, **11% of the natural areas** (like pristine forests) **remaining in 2000 could be lost by 2050**, which equals 7.5 million square kilometers – an area roughly the size of Australia

> Until 2030, the **world's terrestrial biodiversity** is expected to be **reduced to 63.0% of pristine terrestrial biodiversity.** From the pristine state to 2010, factors with the most severe impact on total loss of terrestrial biodiversity were land use for food crop (32%), pasture (18%) and forestry (9%) as well as infrastructure, encroachment and fragmentation (29%). Climate change accounted for a share of 8% in total loss of terrestrial biodiversity to 2010. However looking at 2010-2030 **climate change is expected to cause 33% of terrestrial biodiversity loss**

> A temperature increase of **2.0°C will put 20-30% of species at a much higher risk of extinction.** About 22,000 **species**[1)] of plants and animals are **known to be threatened**[2)] today. By 2030, 60% of coral reefs could be lost through fishing, pollution, diseases, invasive alien species and coral bleaching

> An **aggravating factor for the loss of biodiversity** is seen in threatened **biodiversity hotspots**[3)]. The BRIICS[4)] countries account for 36% of the loss of terrestrial mean species abundance (MSA) from 2010 to 2050. **Amazonia is home to 10% of all worldwide known species**, **Borneo** in Indonesia holds **about 6%**. **Endemic species** in hotspots are particularly under threat of **irreversible extinction** if their livelihood is lost

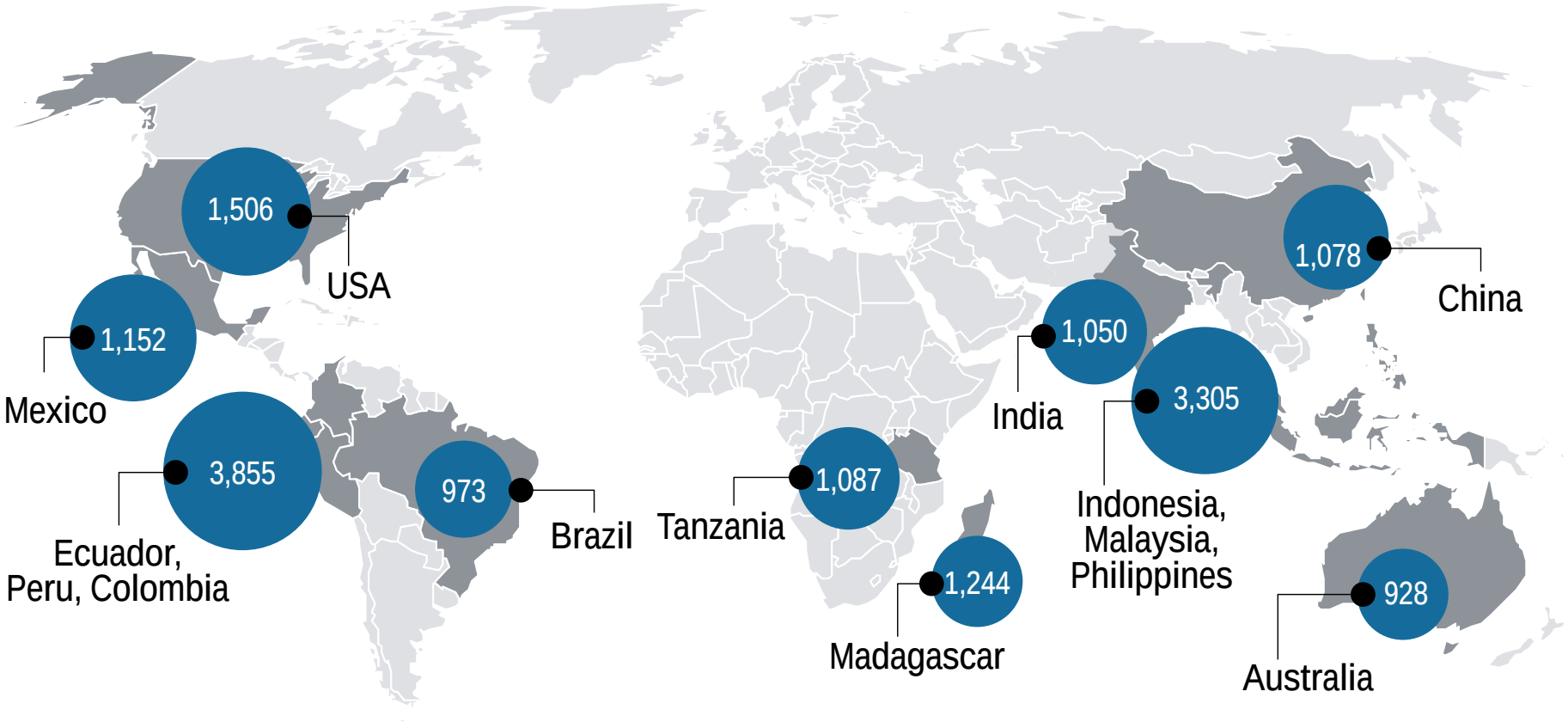
> At the **UN biodiversity conference in Cancún, Mexico** in December 2016, agreements were reached on actions to integrate biodiversity in forestry, fisheries, agriculture and tourism to achieve the 2030 Agenda on Sustainable Development. These are especially set to **reduce environmentally harmful subsidies in agriculture and fisheries**

1) 22,000 species out of 75,000 observed species by IUCN, used as extrapolation for overall existing species on planet 2) Critically endangered, endangered or vulnerable
3) Definition of hotspots: At least 0.5% of vascular plants as endemic and 30% loss of primary vegetation 4) Brazil, Russia, India, Indonesia, China, South Africa

Source: OECD, CBD

Ten regions account for 65% of all threatened species in 2016 – Many of them are endemics

Total amount of threatened species

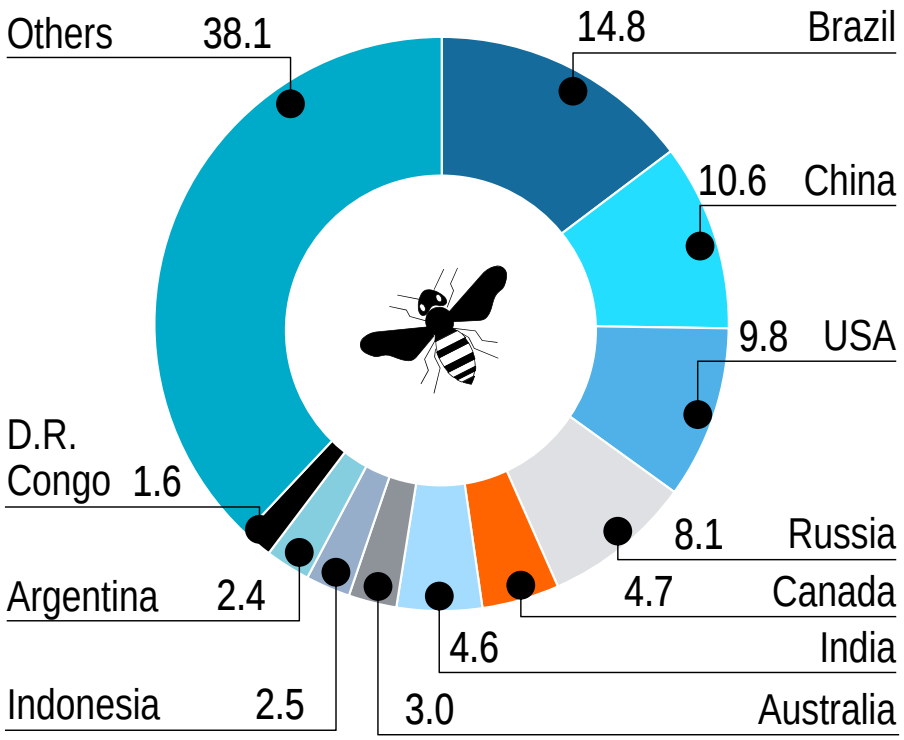


Source: IUCN

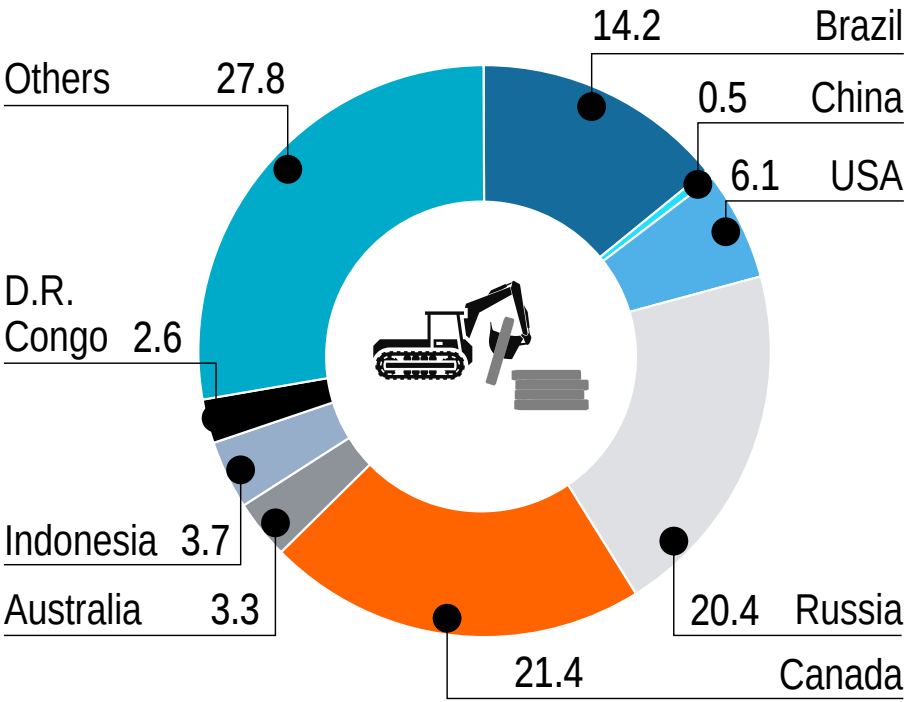
Over 60% of the world's biocapacity is held by only ten countries, most suffer from heavy land and forest degradation

National shares of global biocapacity and forest degradation1) in 2013 [%]

Shares of global biocapacity



Shares of global forest degradation



1) Measured as degradation of intact forest landscape (IFL): IFL is an unbroken expanse of natural ecosystems within the zone of current forest extent, showing no signs of significant human activity, and large enough that all native biodiversity could be maintained. Biocapacity is the ecosystems' capacity to produce useful biological materials and to absorb waste

Source: Global Footprint Network, Intact Forest Landscapes

Rainforest loss is making headlines, but also the northern hemisphere is suffering from strong deforestation

> Between 2000 and 2013 the total intact forest landscapes (IFL) area had decreased by 8.1%. **Canada, Russia and the US** account for **almost 50%** for the vast majority of **IFL degradation**, with Canada leading virgin forest degradation. The main cause for degradation in these countries can be found in commercial interests, especially resource exploitation

> **China** has lost arable land the size of Austria since 1997. **About 40% of China's land is suffering** from land degradation and thus may face a growing food security crisis. **Australia has already lost about 40% of all forests.** National forest degradation continues, fragmenting native vegetation and causing heavy soil erosion through agriculture activities

> **Brazil has lost about 20% of its rainforest.** If this trend were to continue, the **Amazonian rainforest could be reduced by a further 40% in 2030.** However, the deforestation rate in Amazonia has slowed down over the past few years through enforced preservation laws for landowners. Still, absolute deforestation remains on a high total level. Ending tropical deforestation requires a substantive **transformation of the supply chains** of four major commodities – **beef, soy, palm oil and pulp and paper – to deforestation-free methods** according to a recent report by the WEF

> In **Indonesia**, particularly Sumatra, **deforestation is accelerating over past two decades.** Sumatra lost about 50% of its forestation compared to 1985. Borneo's forested area decreased from 95% of its land surface in the 1850s to 50% today. With current deforestation rates, **major forest regions will be lost by 2020**

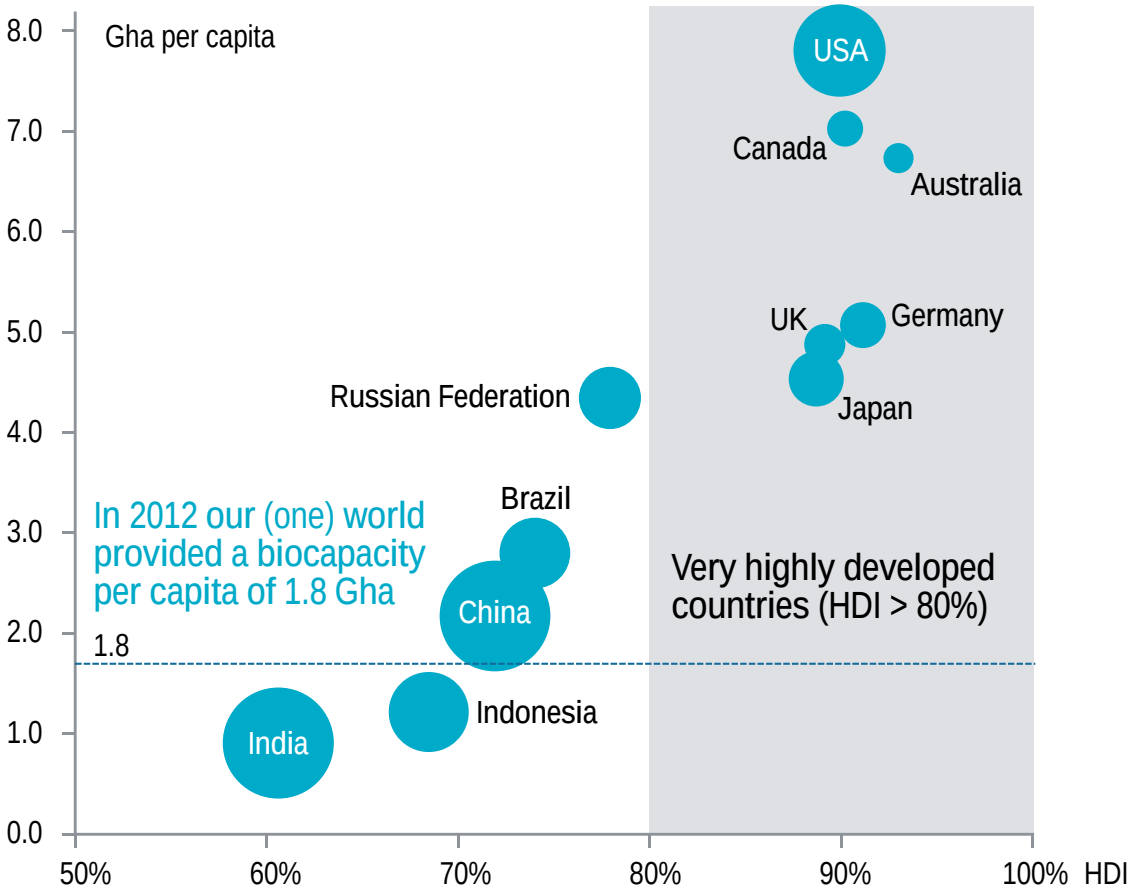
> **Argentina** as well as **India** suffer from a **high share of degraded land.** In Argentina about 40% of population live in such areas; around 50% of Indian land suffers from soil erosion. This leads to desertification and lost productivity in agriculture, whereby new land becomes degraded as farmers move on

> Among the tropical forest regions, the **Congo** basin shows **lowest deforestation rates today.** An expected doubling of population between 2000-2030 in the region makes prevention against degradation increasingly important, since new shelter, food and employment will impact land resources

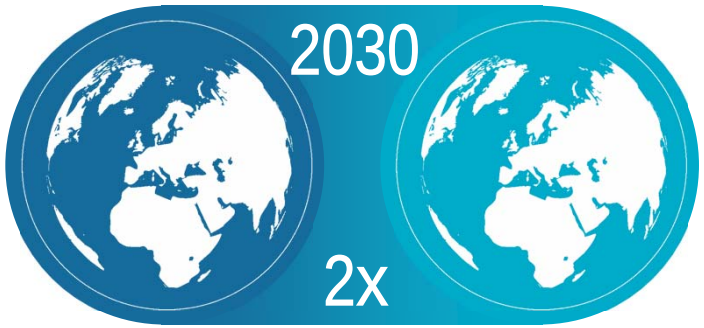
Source: WWF, IFL, World Bank, ISRIC, UN, National Geographic, The University of Adelaide, Huffington Post, WEF

Ecological footprint increases with the state of human development – By 2030 we will require two earths to support our lifestyles

National ecological footprint related to human development index 2010/2014 [Gha[1)]][2)]



- Ecological footprint: Demand of biocapacity securing the current living standard of national populations, weighting strongest CO_2 emissions absorption
- Any imbalance towards required versus actual biocapacity signals that the earth's regenerative capacity is used faster as it is able to regenerate, diminishing the earth's resource stock
- At present, a regenerative capacity equivalent to 1.6 earths is used
- Following a business as usual scenario, humanity will require the combined resources of two earths by 2030



Note: Circle size refers to population size 1) Gha = Global hectare. It measures the average global land area providing usable biocapacity 2) The Human Development Index (HDI) is a composite statistic of life expectancy, education, and income indices. Data for national ecological footprint accounts from 2010, Human Development Index data from 2014

Source: WWF, Global footprint network, UN

Effects of climate change are widely and controversially discussed – But most experts are convinced that risks are significantly greater

Negative alignment

IPCC: Sea level rise and extreme water levels result in asset exposure to the extent of 9% of global GDP

UN: Adapting to climate change in terms of 2 °C causes a global GDP cutback of 4%

IPCC: Inaction causes a global GDP drop of 0.2-2% p.a. if temperature rises up to 2.5 °C

TEEB[1]: Losing biodiversity causes global GDP decrease of 7%

IPCC: Hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss

Trucost[2]: Costs of global biggest 100 environmental externalities total 4.7 USD trillion p.a.

Positive alignment

KPMG survey: About half of companies surveyed expect benefits from climate change

Alfred Wegener Institute[3]: Ships can use the northern sea route of Russia 150 days per year, saving over 7000 km compared to Suez canal route

IPCC: High latitudes benefit from higher crop yields

Richard S.J. Tol[5]: The welfare impact of climate change peaks by 2025 with a global 1.5% GDP rise

UNEP[4]: New Arctic resources will be accessible and ready for exploitation

1) TEEB = The economics of ecosystems and biodiversity: A global initiative focused on drawing attention to the global economic benefits of biodiversity 2) A UK based company providing estimates about the hidden cost of unsustainable use of natural resources by companies 3) Polar and marine research institution 4) UNEP = United Nation Environment Programme 5) Professor at University of Sussex, originally designated as author of the fifth IPCC assessment report, but withdrew position due to disagreement with IPCC interpretations of climate change

Be aware of climate change market opportunities – Use a positive climate reputation as extra boost to your business

- New **business opportunities** will arise as response to climate change in terms of **products**, **production processes**, **reputation** and **brand value**
- Companies need to reduce their CO_2 emissions in order to comply with **legal requirements and improve their reputation**
- On the product side, new **eco-friendly products or technologies** will open up business opportunities and dominate the markets. Companies should focus on using **greener materials**, **reducing packaging and offsetting their carbon footprint** by getting involved in projects to improve the environment
- Companies need to clearly **communicate their achievements in terms of environmental friendliness** and thus **improve their reputation** and brand value. They can further intensify their efforts to actively protect the ecosystem and support biodiversity, for example, by **funding or joining groups** with aligned objectives, such as **FSC**, **Trucost or WWF**
- Through national **adaption to climate change** and **the need for increased resilience in light of extreme climate events**, **new investment opportunities in large-scale infrastructure projects** (e.g. dams) will arise. Investment in the developed world will be followed by emerging market projects, especially the deltaic and island regions of South East Asia

Regulatory policy actions can negatively affect business, but can also accelerate processes in markets

- Based on the Paris Agreement and Marrakesh there is growing international commitment to reduce CO_2 emissions. This naturally affects most energy intensive industries. Therefore, it is recommended to adjust investment strategies and benefit from launching new technologies with a focus on energy efficiency gains. Energy efficiency has been the primary factor in reducing energy consumption in IEA countries over the last 25 years
- The global annual expenditure on energy efficiency will reach 550 USD bn in 2035, about 60% in transport sector, 30% in buildings and 10% in industry. Major regions are Europe, USA, Japan and China
- A financing obstacle is the high share of required private household investment, which amount up to 50% of total investment in energy efficiency, while businesses will account for 40% and governments for 10%. To ensure ongoing investment, not only governments, but also corporations should create investment incentives for the private sector. New financing models by companies can be used to avoid a financing gap in the context of housing insulation, electrical cars or energy-efficient electronic devices
- As a result of policy obligations, there is huge potential for industry enabling efficiency gains within industrial production and for the private sector
- Generally speaking, to reduce CO_2 emissions and pollution is a complex challenge. Companies, NGOs and foundations can contribute to solving these challenges as part of their corporate/organizational responsibility corporate citizenship

Source: ExxonMobil, World Bank, IEA

Re-think established processes and input factors

- Across the value chain, **production and logistics in particular should be optimized**, as they harbor the greatest potential for reducing CO_2 emissions
- **Include** environmental degradation as a **business externality**: Corporations can use **shadow carbon pricing as an internal risk tool** avoiding future, long-term stranded assets e.g. following new policy obligations. IPCC calculated a CO_2 emissions price range of 20-80 USD per ton in 2040 for compensating external costs
- It is advisable for corporations to **increase their independence from oil as an input factor** of production. Less price sensitive resources, such as liquefied natural gas (LNG) for example, yield freedom from major price fluctuations. This is also valid for logistics companies, e.g. changing the equipment to large scale transportation (sea freight), or renew land based transportation to new drive technologies such as gas or hybrid
- **Set ambitious goals** for your business to 2030 regarding the ecological basis of the company. **Green energy production, sustainable industry processes and green consumer goods** have better chances to stay competitive across global markets

Source: OECD

Key sources and further reading (1/2)

Most important data sources

> IEA. Energy Technology Perspectives 2016 - Towards Sustainable Urban Energy Systems
http://www.iea.org/etp/

> IPCC. Fifth Assessment Report (AR5)
https://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

> Climate Interactive. C-ROADS – Climate Change Policy Simulator
https://www.climateinteractive.org/tools/c-roads/

> ExxonMobil. The Outlook for Energy 2017: A View to 2040
http://cdn.exxonmobil.com/~/media/global/files/outlook-for-energy/2017/2017_outlook_for_energy.pdf

> The World Bank. The Economics of Adaption to Climate Change – Synthesis report
http://documents.worldbank.org/curated/en/2010/01/16436675/economics-adaptation-climate-change-synthesis-report

> OECD. Environmental Outlook to 2050
http://www.oecd.org/environment/indicators-modelling-outlooks/oecd-environmental-outlook-1999155x.htm

> WWF. The Living Planet Report 2016
http://wwf.panda.org/about_our_earth/all_publications/lpr_2016/

Key sources and further reading (2/2)

Further reading

- U.S. Energy Information Administration (EIA). Annual Energy Outlook 2017
  http://www.eia.gov/outlooks/aeo/
- IEA. The Changing Landscape of Energy Investment
  https://www.iea.org/newsroom/news/2017/february/the-changing-landscape-of-energy-investment.html
- UNEP Frontiers 2016 Report: Emerging Issues of Environmental Concern
  https://web.unep.org/frontiers/sites/unep.org.frontiers/files/documents/unep_frontiers_2016.pdf
- The Economics of Ecosystems and Biodiversity in Business and Enterprise
  http://www.teebweb.org/publication/the-economics-of-ecosystems-and-biodiversity-teeb-in-business-and-enterprise/
- National Intelligence Council (NIC). Global Trends. Paradox of Progress
  https://info.publicintelligence.net/ODNI-NIC-ParadoxProgress.pdf
- Global Forest Watch
  http://www.globalforestwatch.org/map/3/32.58/162.75/ALL/grayscale/602,591?threshold=10
- WEF. The Role of the Financial Sector in Deforestation-free Supply Chains
  https://www.tfa2020.org/wp-content/uploads/2017/01/TFA2020_Framing_Paper_130117.pdf

Please contact us if you have any questions or comments – Six more megatrend insights await on our website

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Trend Compendium

https://www.rolandberger.com/en/Dossiers/Trend-Compendium.html

The bigger picture for a better strategy

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