

Adaptation to Climate Change



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Overview:

1. Introduction
2. Human activities on climate change
3. Adaptation needs
4. Adaptation options
5. Adaptation planning and implementation
6. Adaptation opportunities, constraints and limits
7. Economics of adaptation

What is climate change?

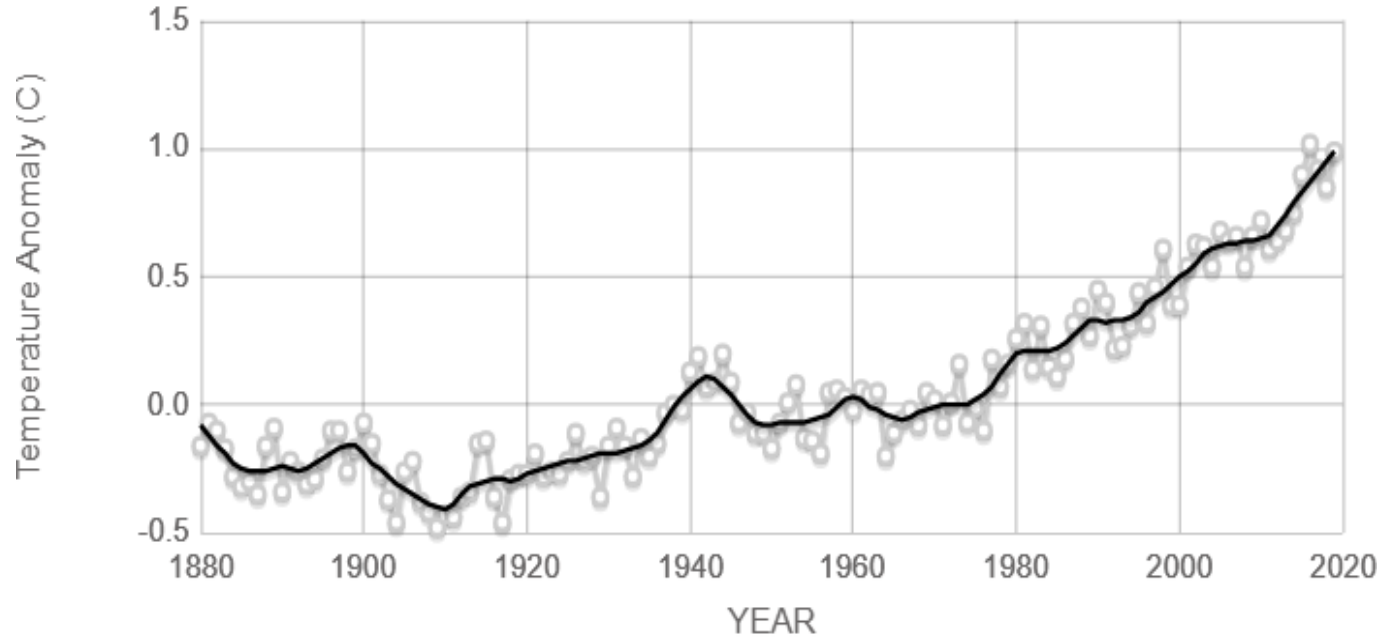
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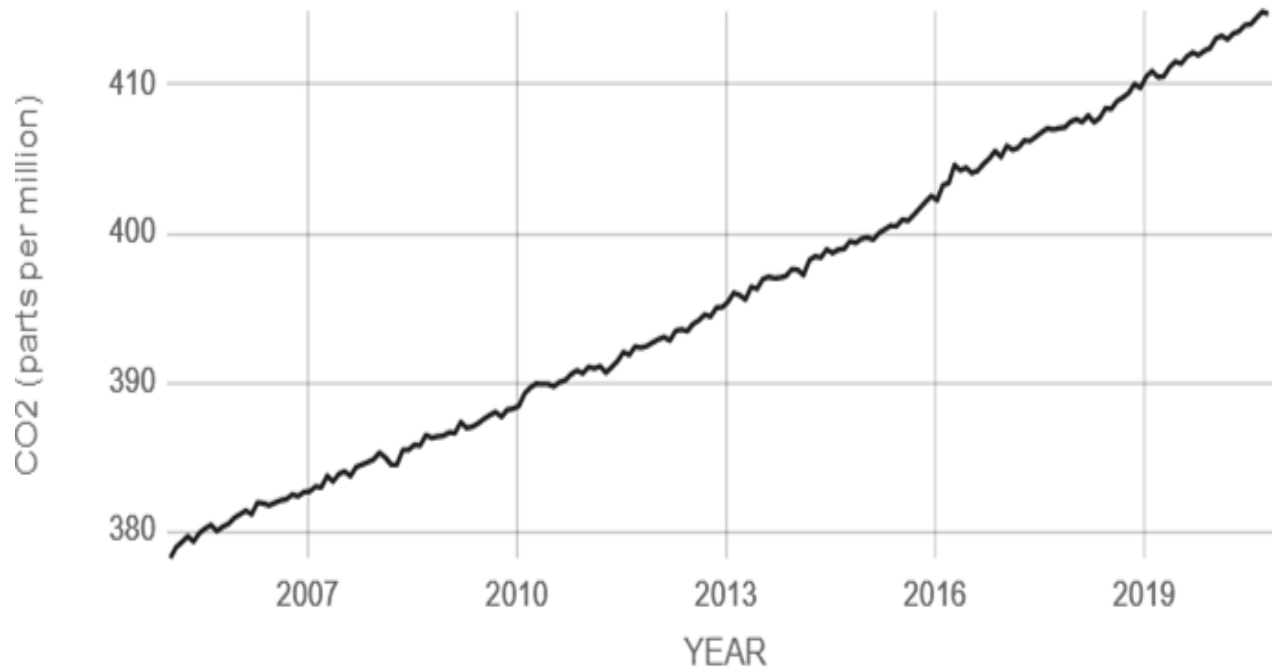
International Academies: Joint Statement

"**Climate change is real.** There will always be uncertainty in understanding a system as complex as the world's climate. However there is now strong evidence that significant global warming is occurring. **The evidence comes from direct measurements** of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001)."

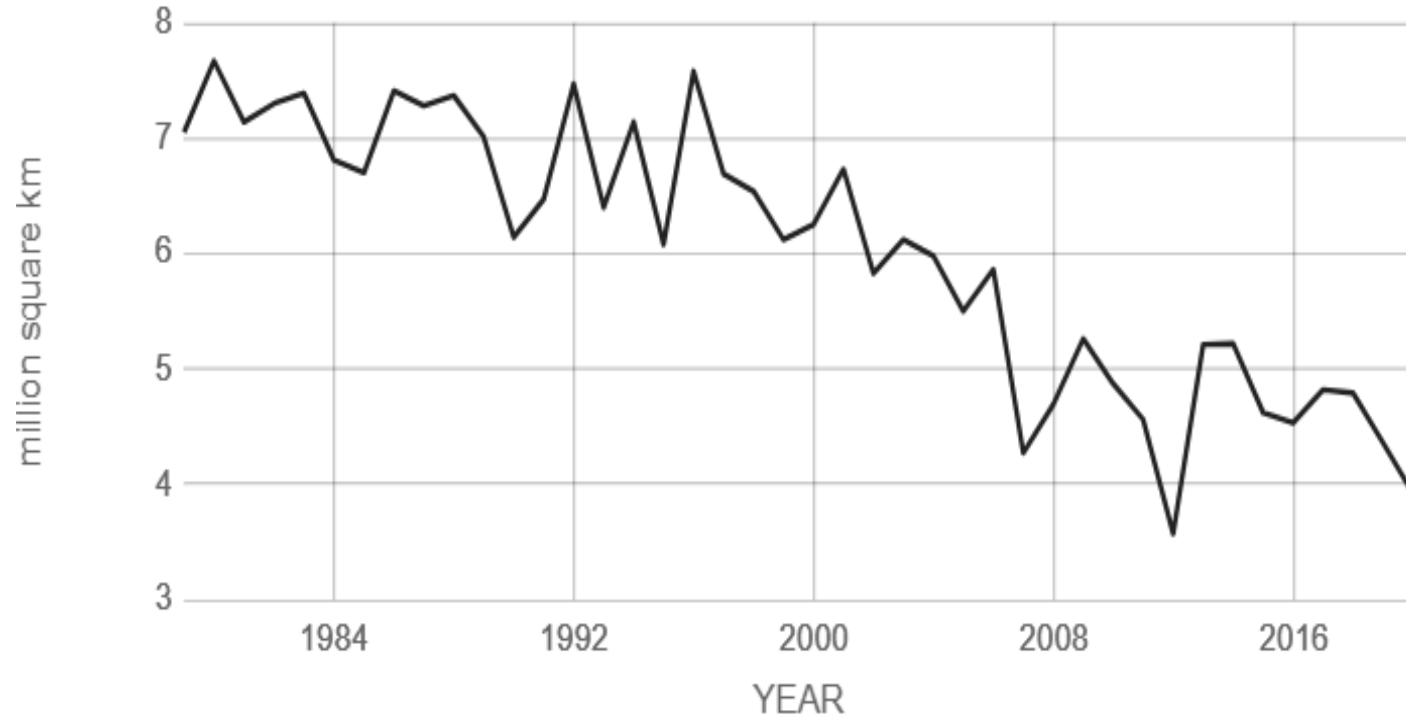
The change in global surface temperature relative to 1951-1980 average temperatures

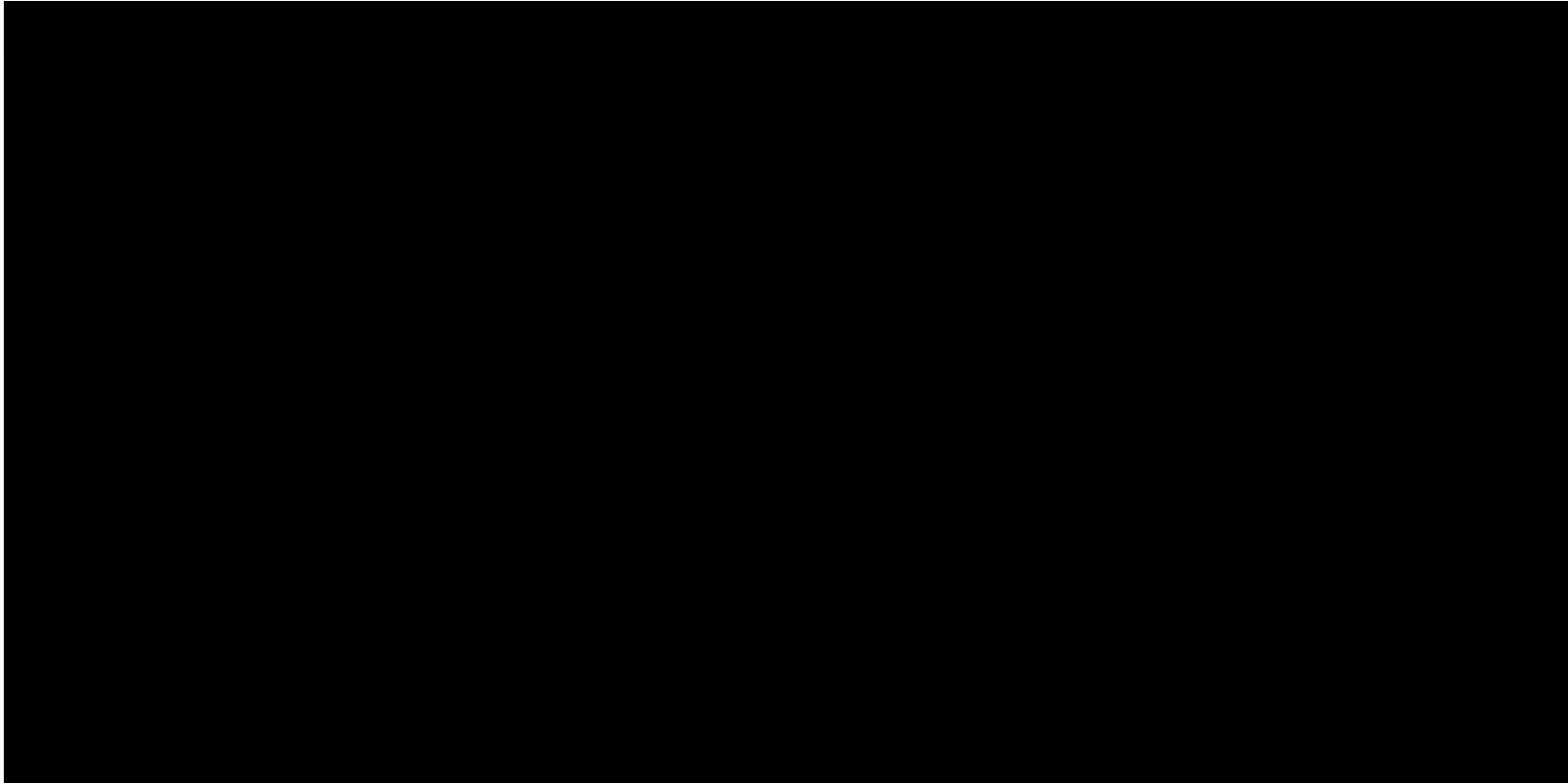


Atmospheric CO2 levels measured at Mauna Loa Observatory, with average seasonal cycle removed



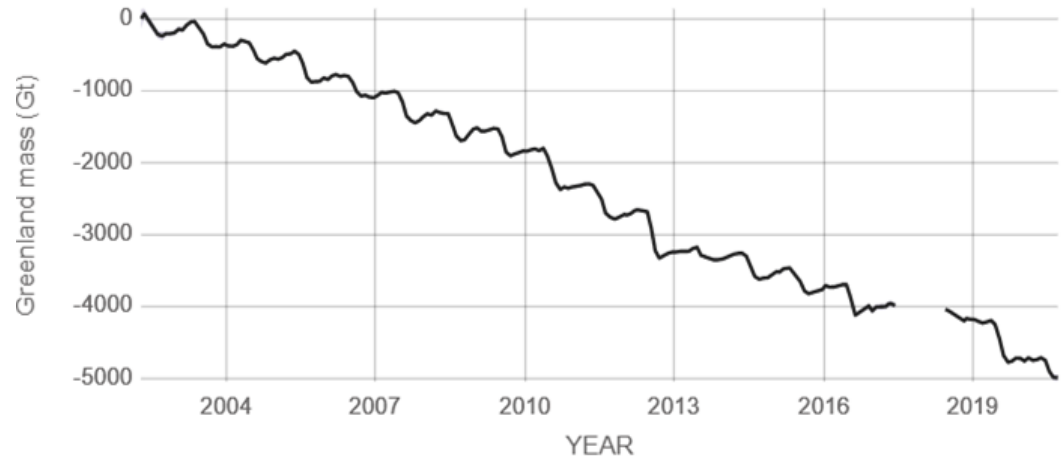
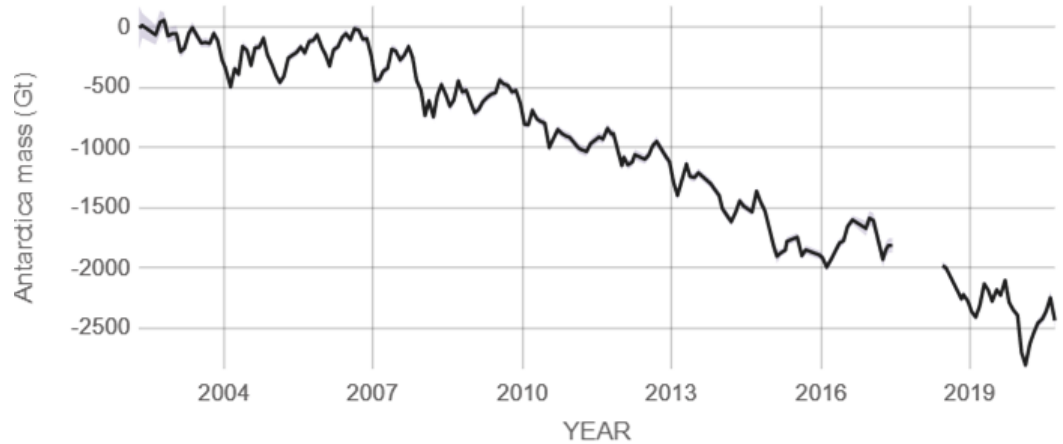
The average monthly Arctic sea ice extent each September since 1979, derived from satellite observations



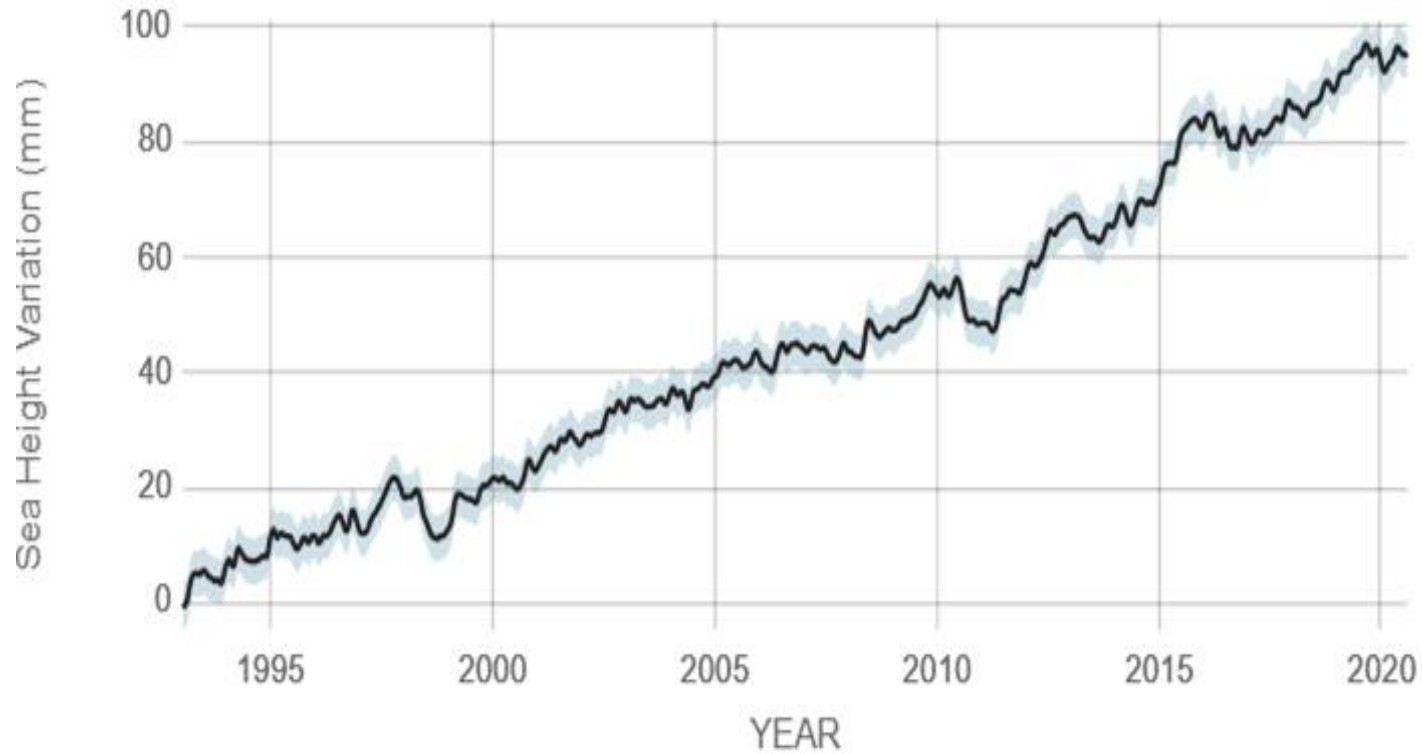


Mass loss of the land ice sheets in both Antarctica (upper chart) and Greenland (lower chart).

Data from NASA's GRACE and GRACE Follow-On satellites.



The change in sea level since 1993 as observed by satellites



Human activities on climate change





Human activities are impacting the climate system





Almost all studies related to extreme heat indicate human influence. This is consistent with IPCC AR5 findings that it is very likely human influence has contributed to observed global scale changes in the frequency and intensity of daily temperature extremes since the mid-20th century.



A smaller but increasing number detect a human influence in rainfall extremes. This is consistent with IPCC AR5 findings that it is likely anthropogenic influences have affected the global water cycle since 1960.

Could climate change make Earth uninhabitable for humans?



Making Earth uninhabitable for humans.

Increasing the risk of other existential risks

Contributing to the likelihood of societal collapse

Why climate change is creating a new generation of child brides?



Figure: https://www.theguardian.com/society/2017/nov/26/climate-change-creating-generation-of-child-brides-in-africa?fbclid=IwAR2Oj7ccwWMqgXbYqYN_cAHNcy3p1gSv73ddChPLGb50qekNlaVMmuWwcGg

Human-induced climate change...



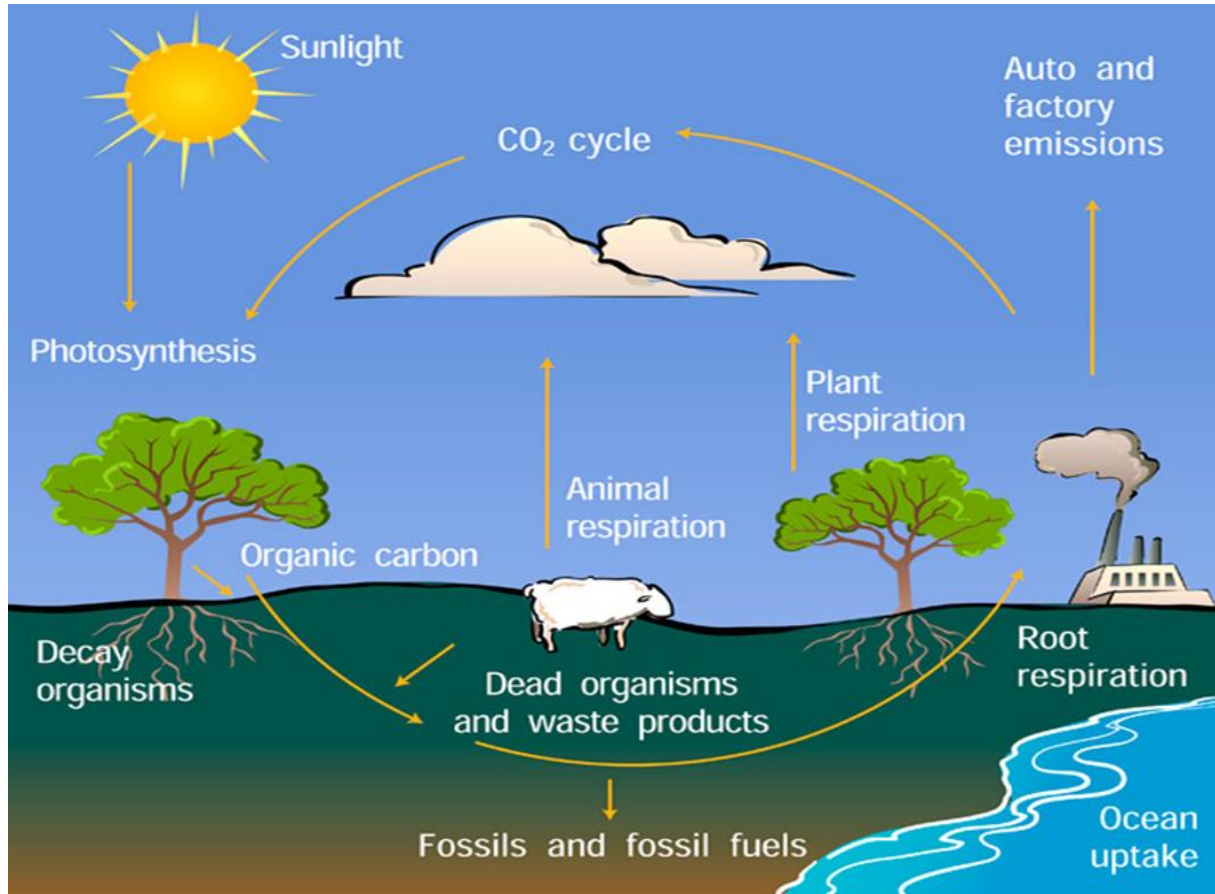


Figure: <https://youmatter.world/en/greenhouse-gases-co2-decarbonizing-28439/>

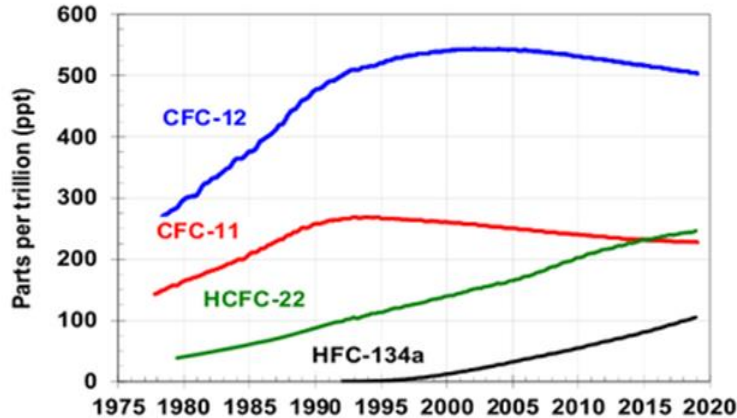
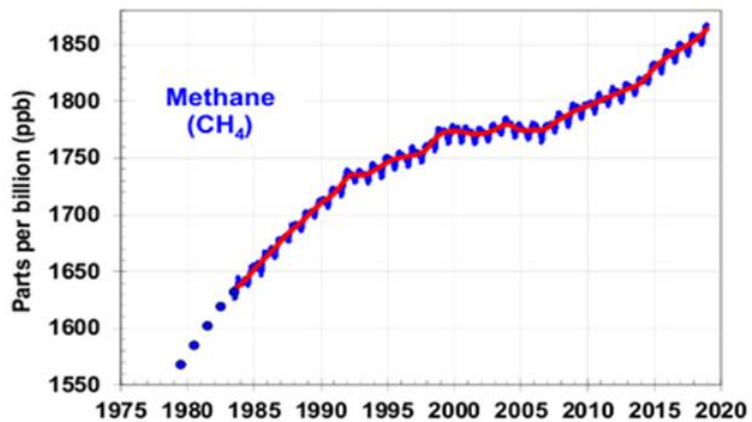
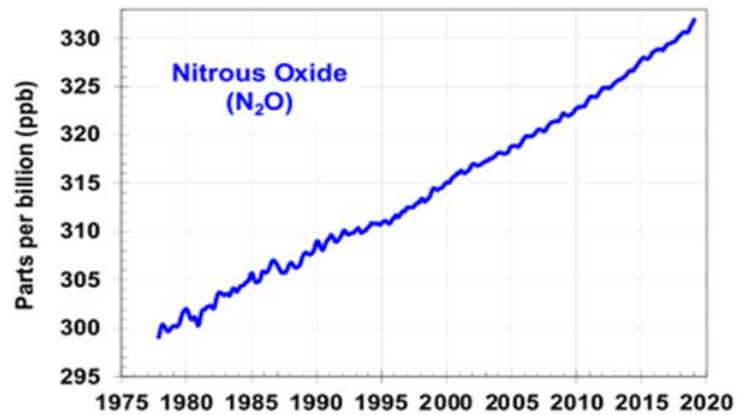
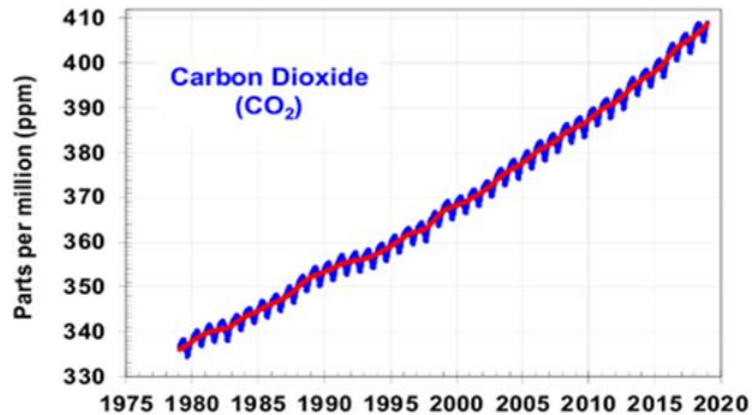


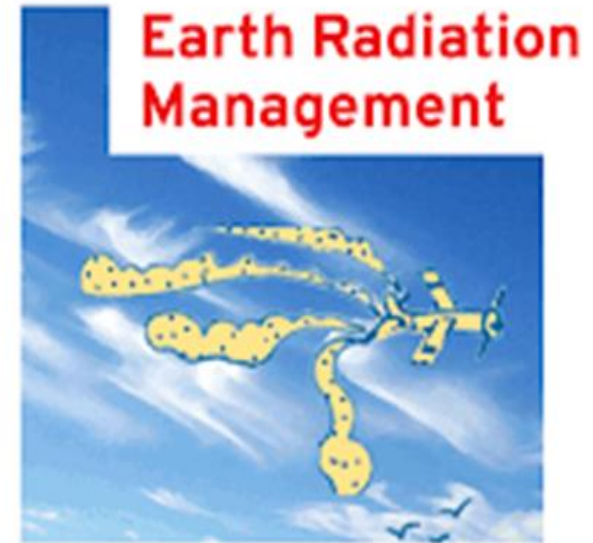
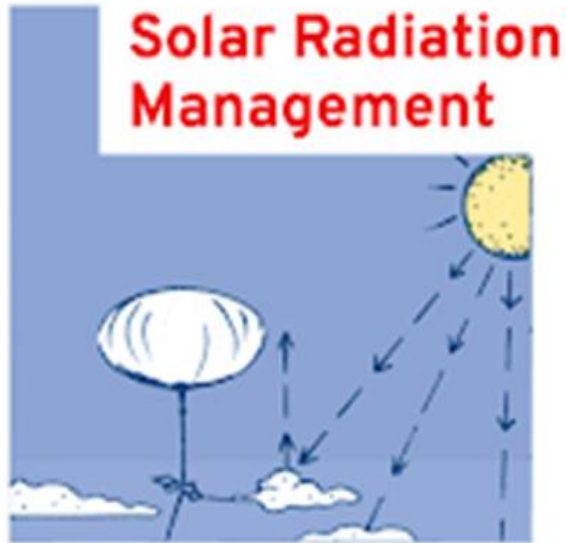
Figure: <https://www.azimuthproject.org/azimuth/show/Greenhouse+gas>



Can we block the sun?



Geoengineers' risky plan to block out the sun



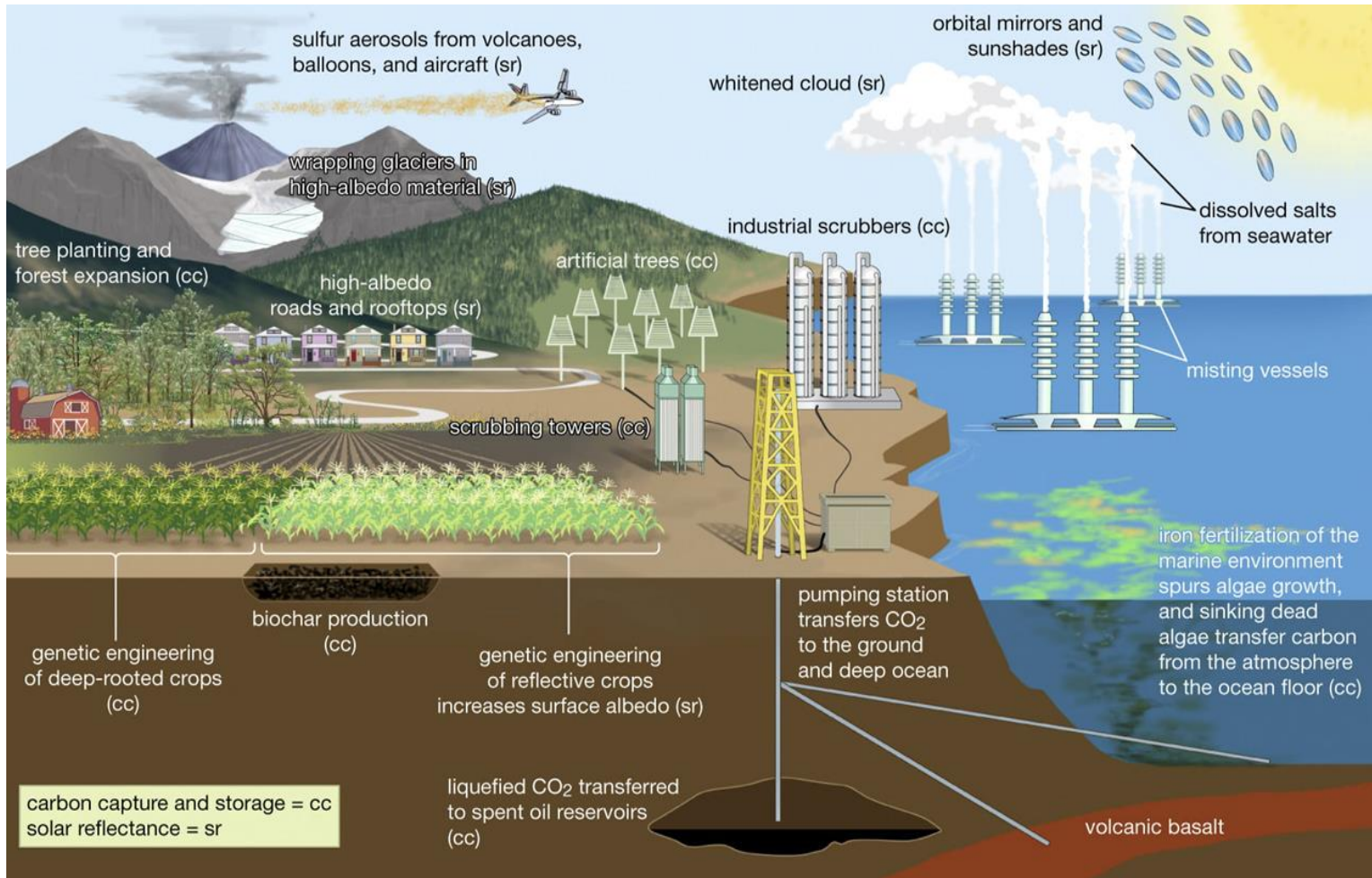
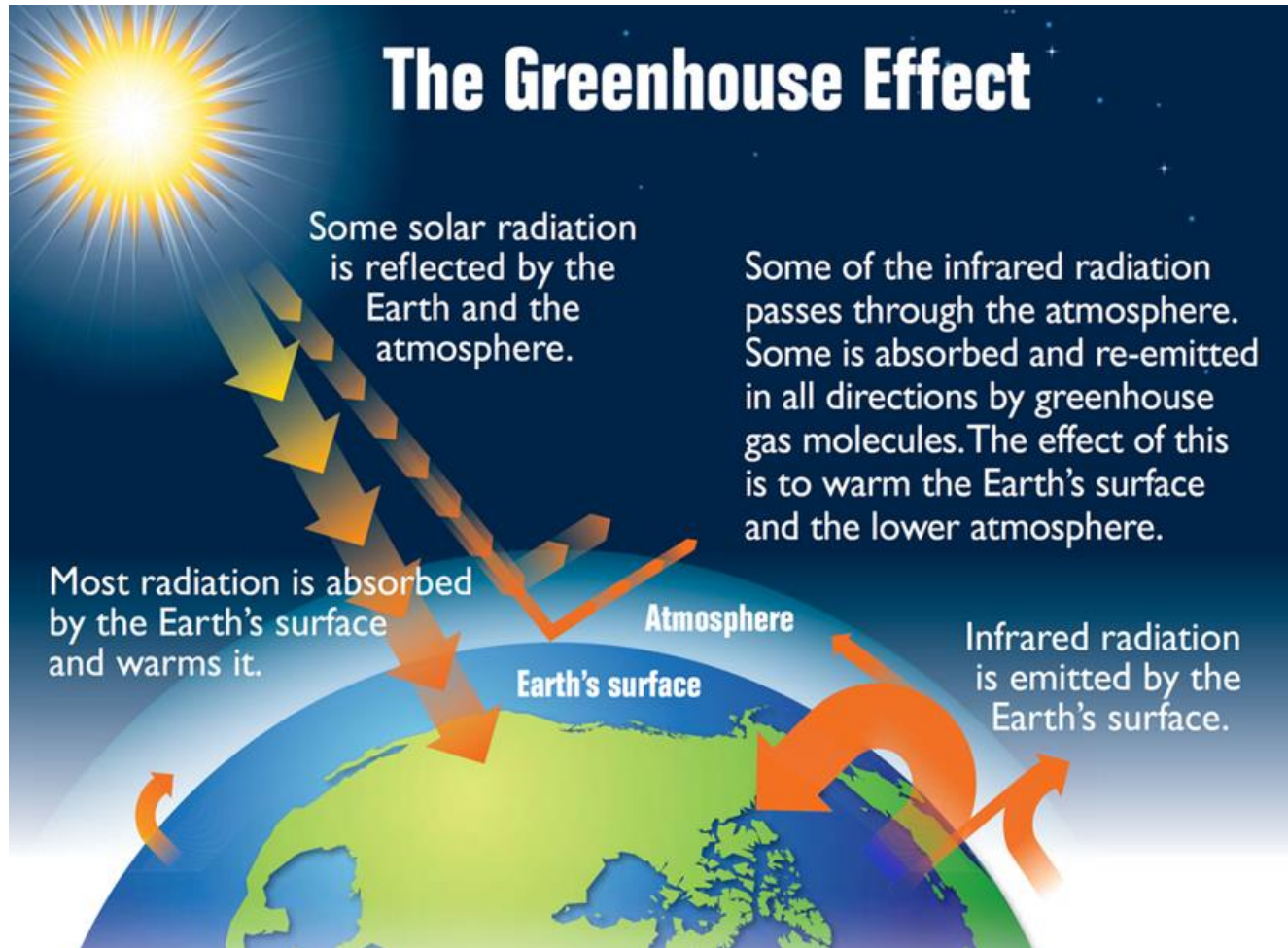


Figure: <https://www.digitaltrends.com/cool-tech/geoengineering-to-save-humankind/>

The Greenhouse Effect



What is adaptation?

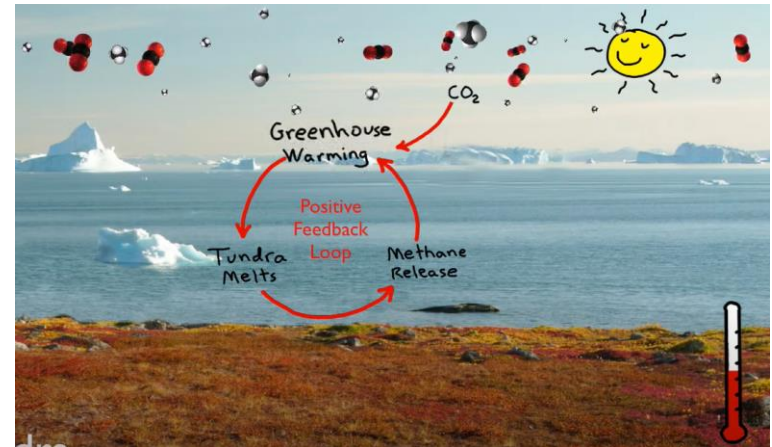
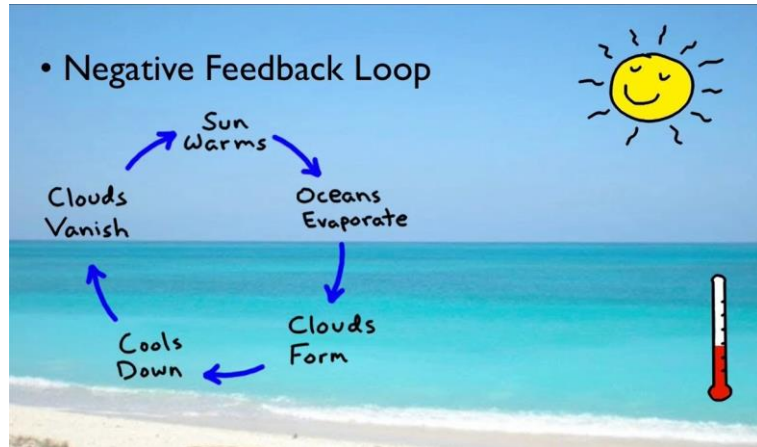
A decorative pattern at the bottom of the slide consisting of a series of overlapping, semi-transparent circles in various shades of teal and light blue, creating a textured, wave-like effect.

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects...



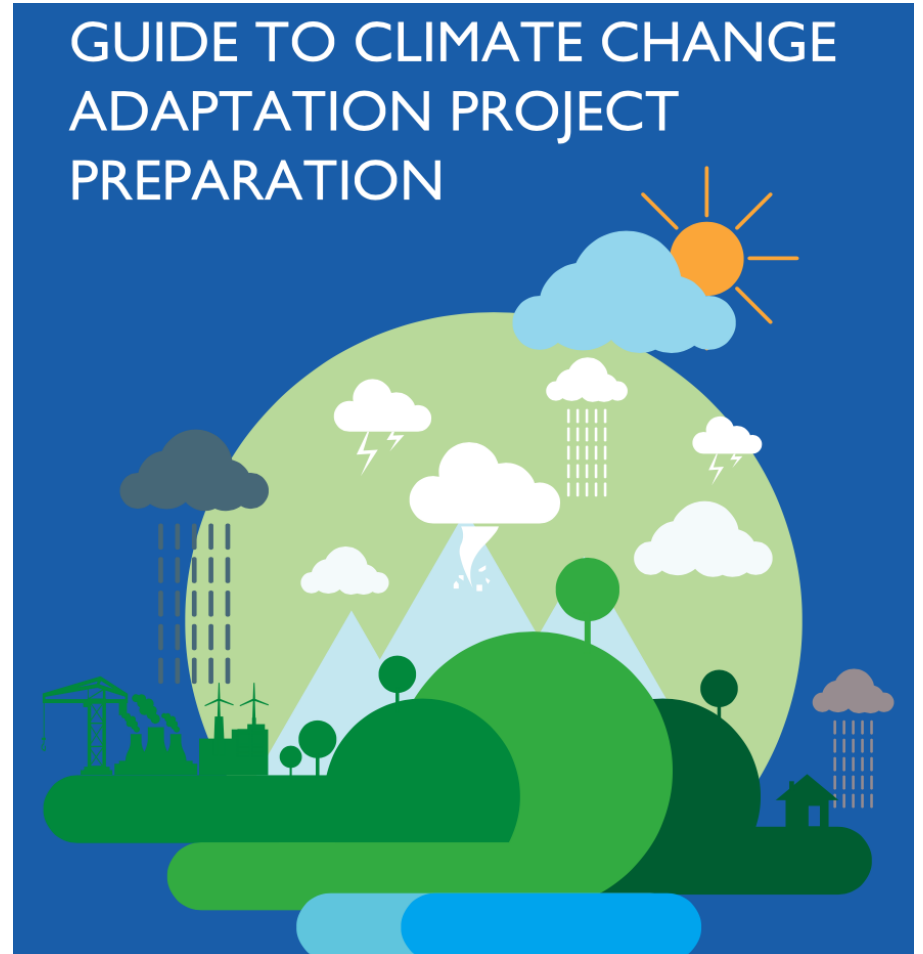
Figure: <https://app.croneri.co.uk/feature-articles/building-adaptation-climate-change>

Natural systems have the potential to adapt through multiple **autonomous processes** (e.g., phenology changes, migration, compositional changes, phenotypic acclimation, and/or genetic changes)



GUIDE TO CLIMATE CHANGE ADAPTATION PROJECT PREPARATION

Successful adaptation will depend on our ability to allow and facilitate natural systems to adjust to a changing climate, thus **maintaining the ecosystem services** on which all life depends



Incremental adaptation

Actions where the central aim is to **maintain the essence and integrity** of the existing technological, institutional, governance, and value systems.

Transformational adaptation

Implementing **changes in the fundamental attributes of systems** in response to actual or expected climate and its effects, often at a scale and ambition greater than incremental activities.

In the process of building future adaptive capacity it is important to **reduce the current adaptation deficit** along with **designing effective risk management and climate change adaptation measures**. Failure to close the adaptation deficit, both current and in the future, will result in residual damages from climate change.

Adaptation needs

The background is a solid orange color. In the top right corner, there are three decorative elements: a small circle, a larger circle containing a smaller circle, and another small circle, all in varying shades of orange.

What is that?

Adaptation needs arise when the anticipated risks or experienced impacts of climate change **require action to ensure the safety of populations and the security of assets**, including ecosystems and their services.





Categorization of adaptation needs

- Biophysical and environmental needs
- Social needs
- Institutional needs
- Private sector needs
- Information, capacity and resource needs

Biophysical and environmental needs





Biophysical and environmental needs





Biophysical and environmental needs

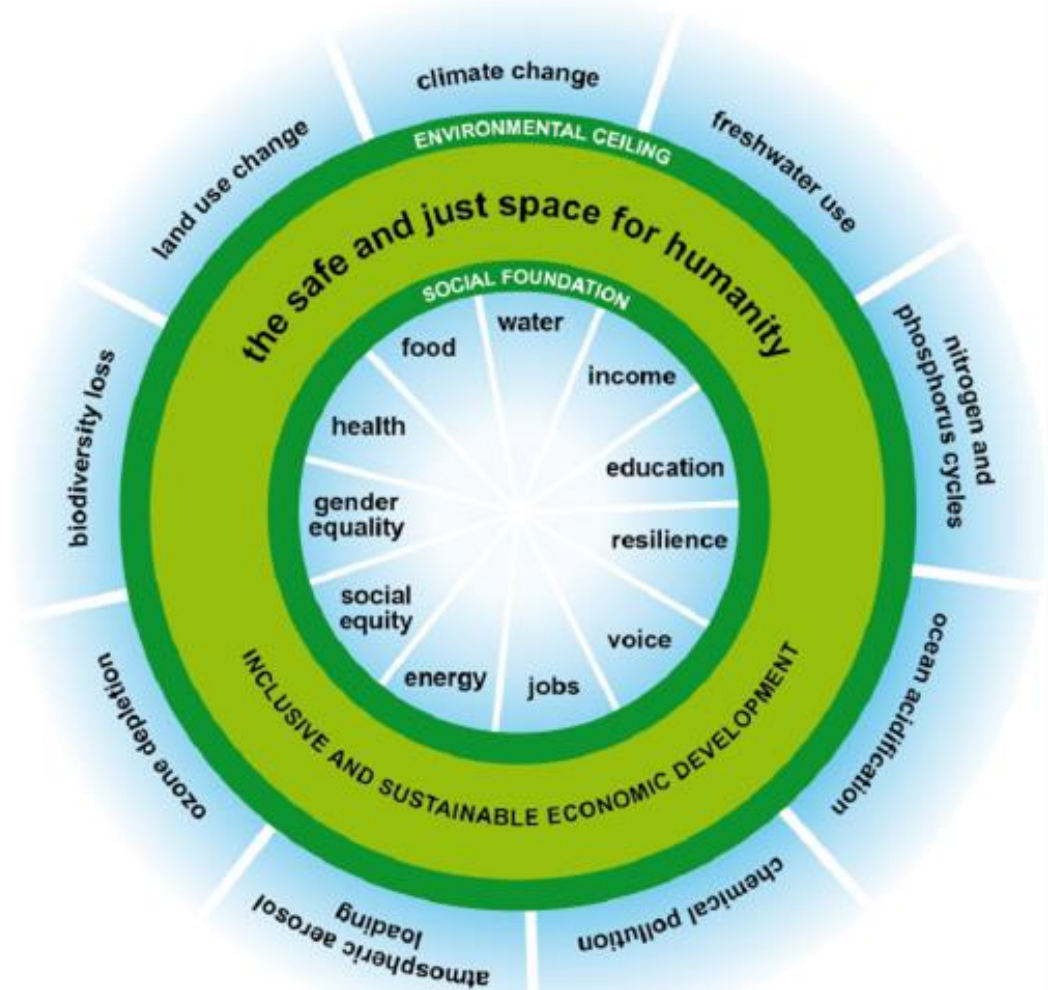
Need to protect the ecosystem along with its resources

Need to focus on delivering ecosystem services

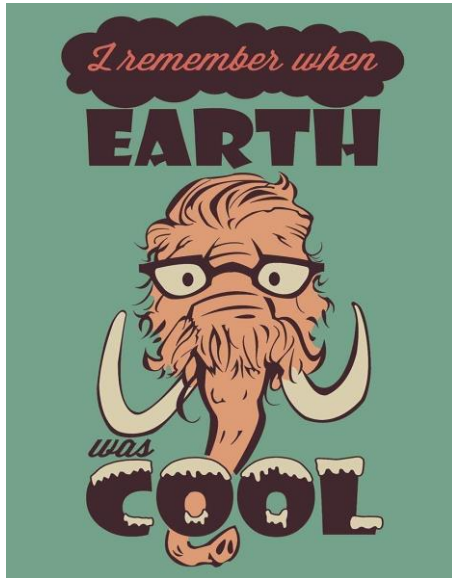
Need to improve understanding and valuation of ecosystem services

Need for appropriate ecosystem monitoring

Social needs



Social needs



Figures: earth was cool: Dare Studios poster; bear: www.savethearctic.com; panda: © Victor Van Gaasbeek



Social needs

Need to take into account emotional and psychological needs

Need to focus on going from local to national

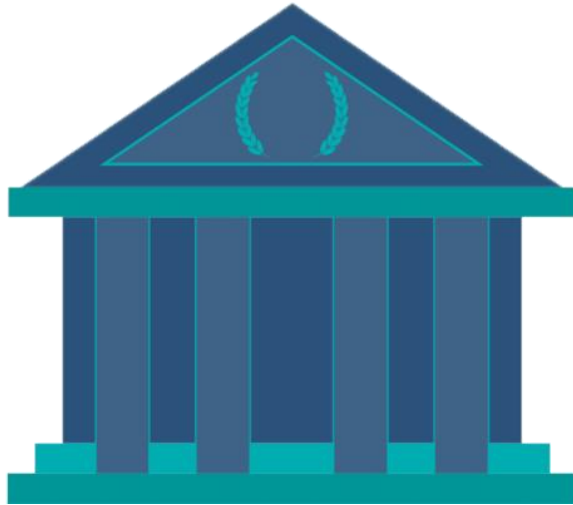
Need for stability of livelihood

Need for livelihood strategies

Need for addressing inequities and development differences

Need for education and access to information

Institutional needs





Institutional needs

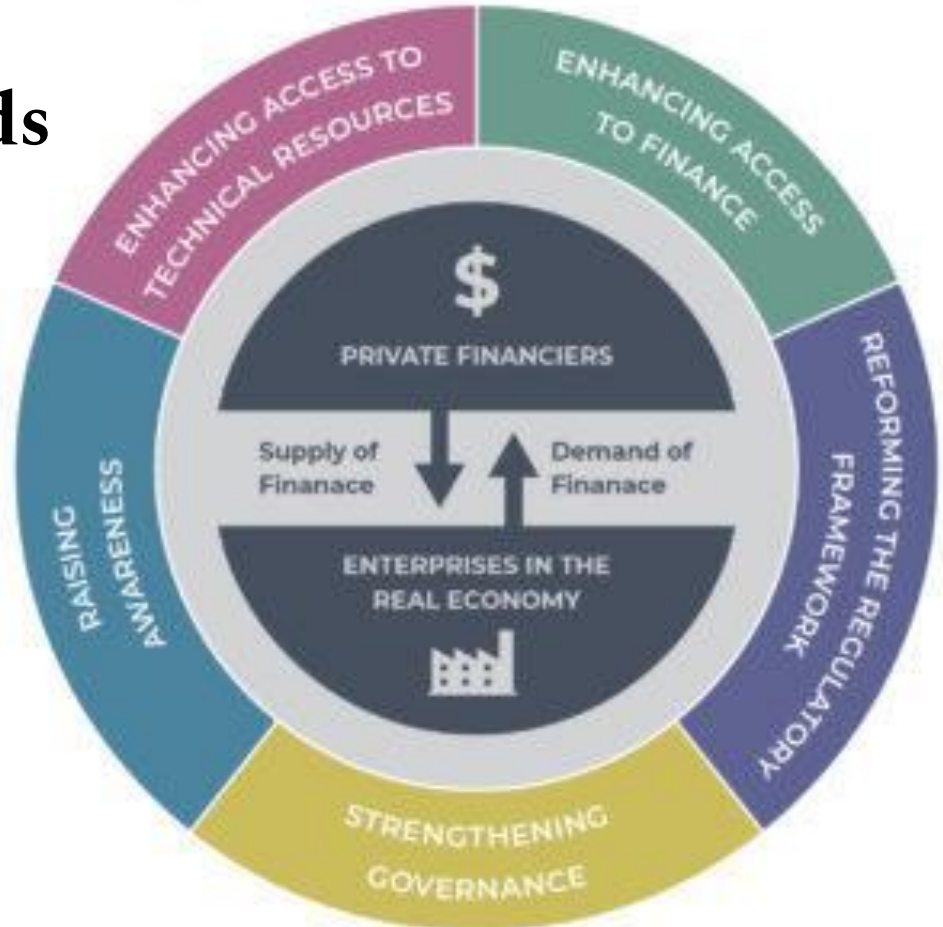
Need to address long-term issues

Need to match the appropriate institutional scale with the scale of implementation

Need for promoting and implementing adaptation strategies

Need for advancing the adaptation agenda

Private sector needs





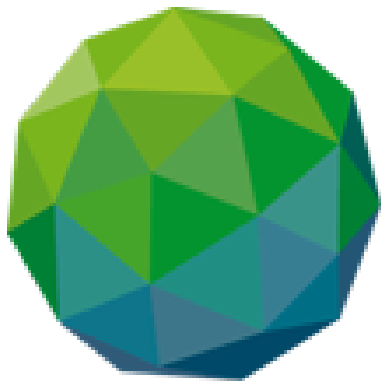
Private sector needs

Need for private sector engagement and investment in adaptation

Need to engage in the cost-benefit analysis of adaptive actions

Need to integrate the long-term risks of climate change into their managing business risk sector

Information, capacity and resource needs



**GREEN
CLIMATE
FUND**





Information, capacity and resource needs

Need to promote information acquisition and dissemination

Need for greater knowledge on costs and benefits

Need to develop financial instruments for resources delivering

Need for disaster preparedness and building resilience

Need for finance to reach the most vulnerable people

Adaptation options

The background is a solid orange color. In the top right corner, there are several decorative elements: a small circle, a larger circle containing a smaller circle, and another small circle, all in varying shades of orange.

What is that?

Adaptation aims to manage climate risk to an acceptable level, taking advantage of any positive opportunities that may arise. Adaptation options are **measures and actions that can be implemented to improve adaptation to climate change.**





Categorization of adaptation options

- Structural and physical options
- Social options
- Institutional options



Structural and physical options

→ **Engineered and build environment**

→ Technological

→ Ecosystem-based

→ Services



Flood levees





Culverts

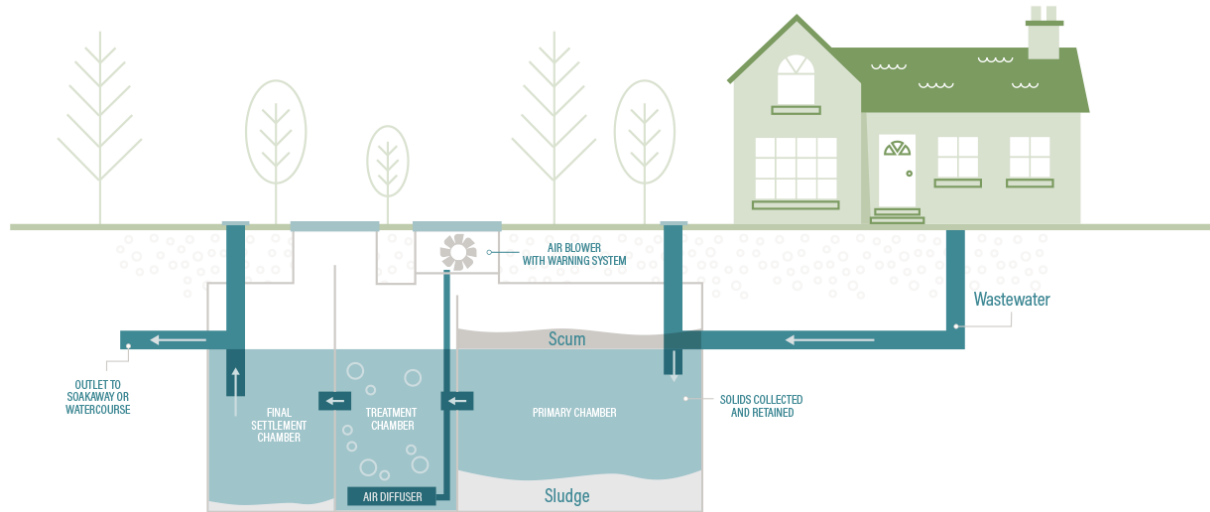


Figure: <https://www.khplant.co.za/blog/article/grading-culvert>



Sewage works

How a Sewage Treatment Plant works





Structural and physical options

→ Engineered and build environment

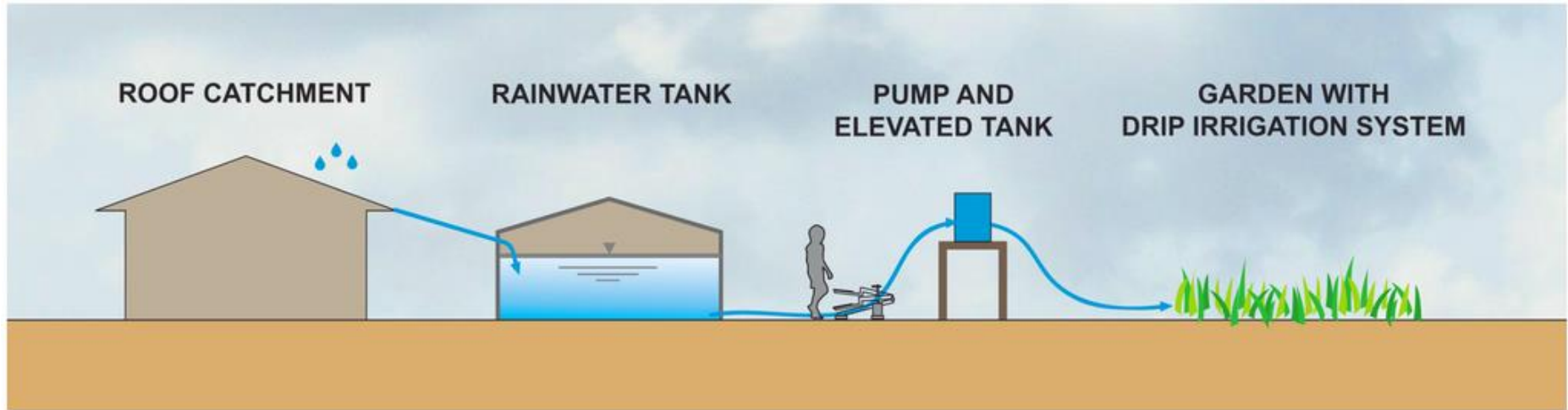
→ **Technological**

→ Ecosystem-based

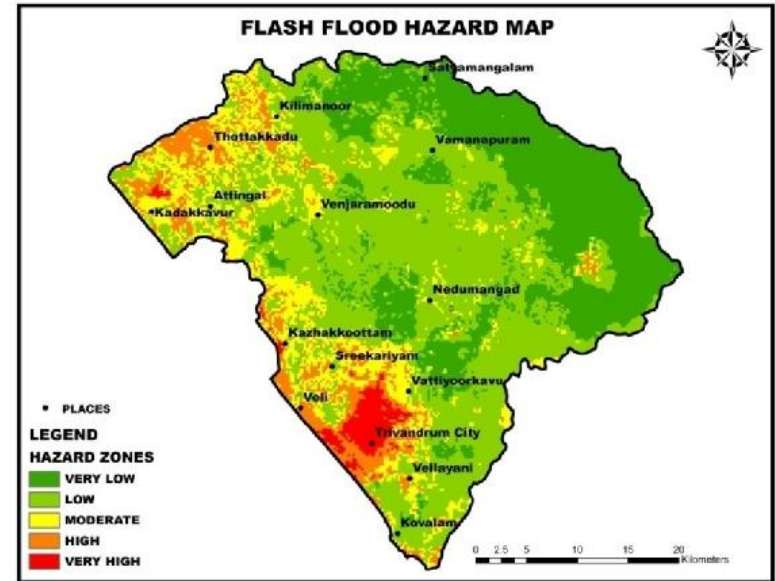
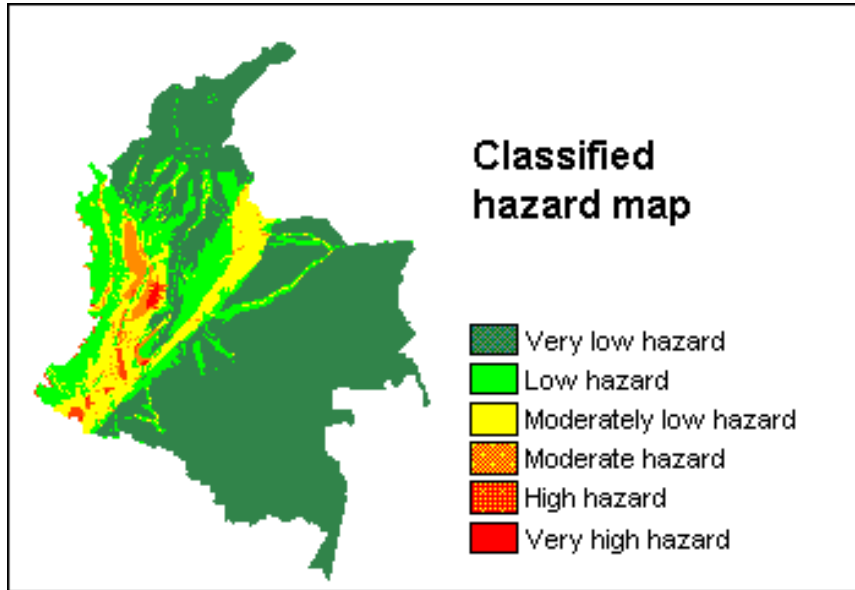
→ Services



Rainwater harvesting



Hazard mapping





Structural and physical options

- Engineered and build environment
- Technological
- **Ecosystem-based**
- Services



Reforestation and afforestation



Overfishing control





Structural and physical options

- Engineered and build environment
- Technological
- Ecosystem-based
- **Services**

Food banks



Figures: <https://pl.postermymwall.com/index.php/art/template/b80952831f5ff83a268c97e30317f51c/giving-tuesday-8-design-template#.X9fIVthKqog>;
<https://www.theguardian.com/society/2017/jun/29/biggest-ever-study-of-food-banks-warns-use-likely-to-increase>

Vaccination programs





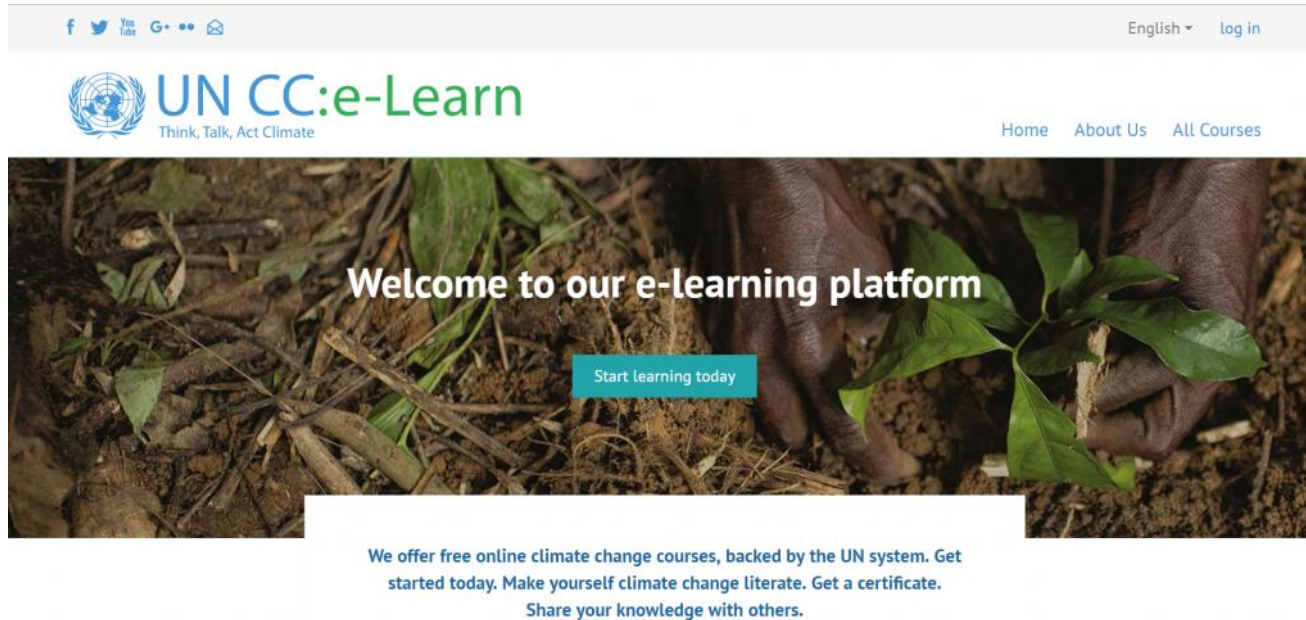
Social options

→ **Educational**

→ Informational


→ Behavioral

Learning platforms



f Twitter YouTube G+ Email

English ▾ log in

 **UN CC:e-Learn**
Think, Talk, Act Climate

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We offer free online climate change courses, backed by the UN system. Get started today. Make yourself climate change literate. Get a certificate. Share your knowledge with others.

Awareness raising and integrating into education



Figures: <https://news.utexas.edu/2018/09/12/amid-climate-change-hope-can-help-inspire-change/>; greenqueen.com.hk/new-jersey-becomes-first-u-s-state-to-require-schools-to-teach-climate-change-2/



Social options

→ Educational

→ **Informational**

→ Behavioral



Slum upgrading





Health warning systems





Social options

→ Educational

→ Informational

→ **Behavioral**



Soil and water conservation



Changing livestock practices





Institutional options

→ **Economic**

→ Laws and regulations

→ Government policies and programs

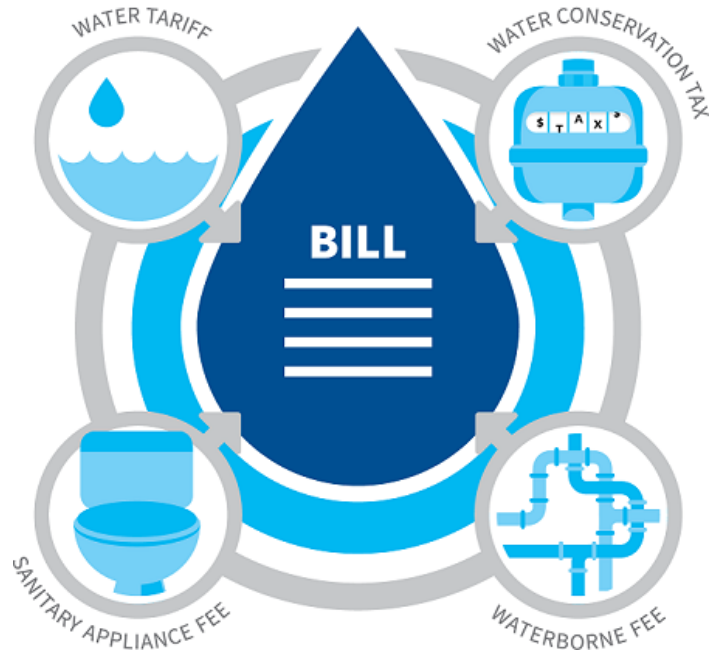


Insurance and catastrophe bonds



Figures: <https://theonebrief.com/how-record-catastrophe-bond-issuances-are-changing-the-alternative-investment-landscape/>
https://www.rand.org/pubs/research_briefs/RBA635-1.html

Water tariffs





Institutional options

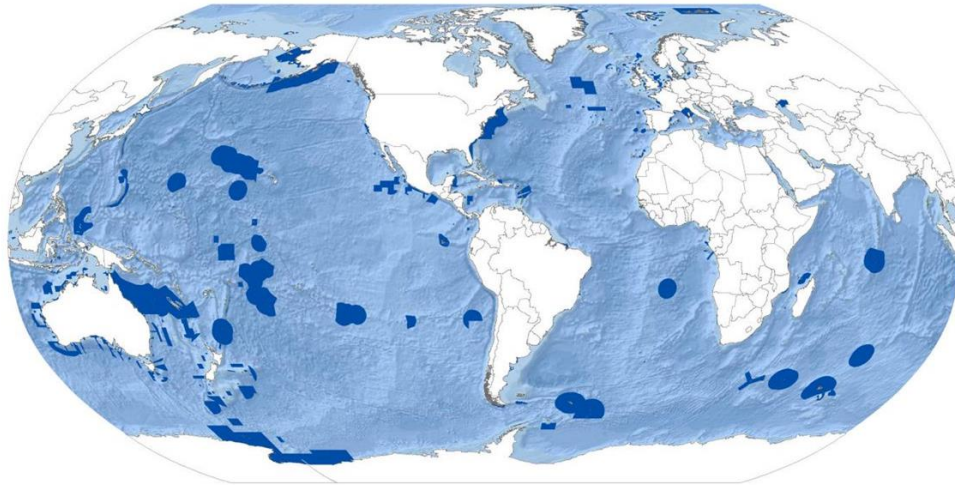
→ Economic

→ **Laws and regulations**

→ Government policies and programs

Marine Protected Areas

Official MPA Map



Source: UNEP-WCMC AND IUCN (2017), Protected Planet: The World Database on Protected Areas (WDPA) [On-line], October, 2017, Cambridge, UK; UNEP-WCMC. Available at www.protectedplanet.net



6.35% of the Global Ocean covered by protected areas
1.89% exclusively no-take.





Patent pools and technology transfer



Figures: <https://theonebrief.com/how-record-catastrophe-bond-issuances-are-changing-the-alternative-investment-landscape/>
https://www.rand.org/pubs/research_briefs/RBA635-1.html



Institutional options

→ Economic

→ Laws and regulations

→ **Government policies and programs**

Ecosystem-based management

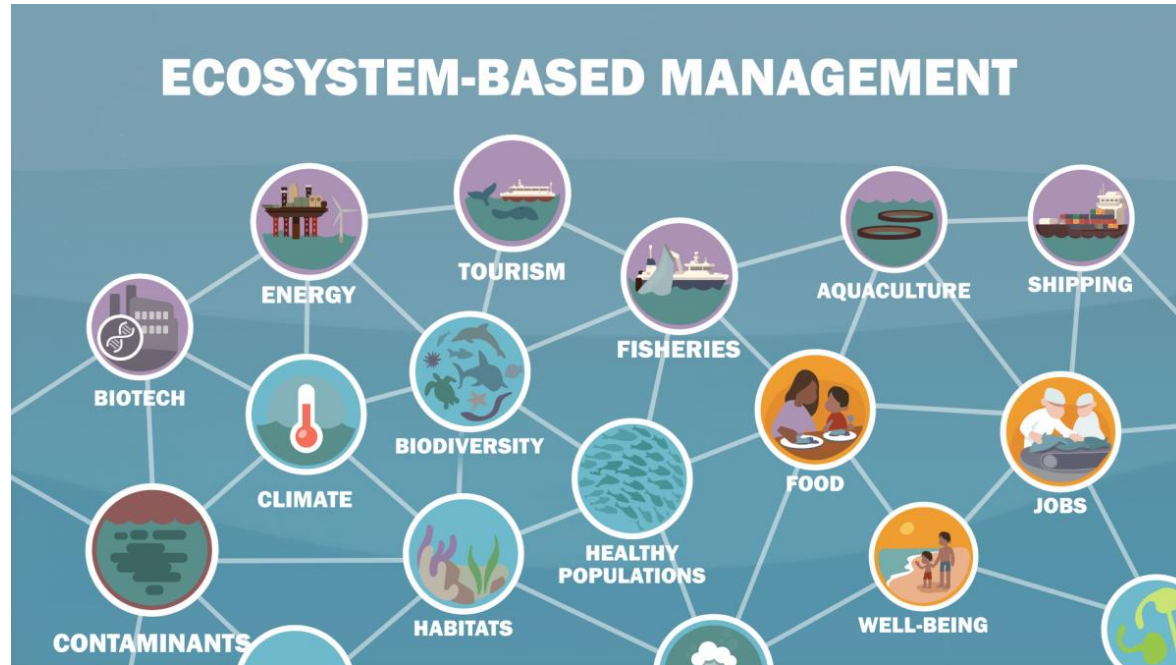
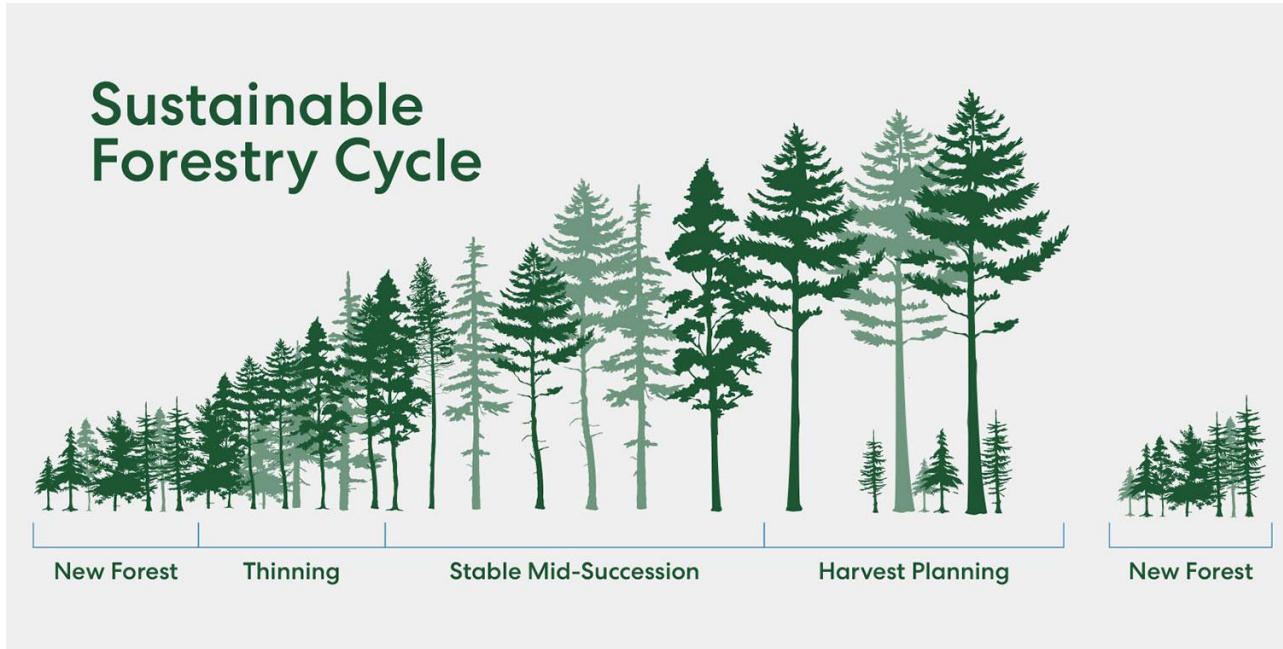


Figure: <https://www.atlanticresource.org/aora/site-area/blog/ecosystem-approach-ocean-health-and-stressors-video>

Sustainable forest management



Adaptation planning and implementation

The background is a solid orange color. In the upper right quadrant, there are several decorative elements: a small circle, a larger circle with a smaller circle inside it, and another small circle below the larger one. All these circles have a gradient and some internal shading, giving them a 3D or layered appearance.

Adaptation planning at different levels

Common recognition and international mechanisms

National initiatives

Subnational and local activities

Common recognition and international mechanisms



Figure: The Green Climate Fund programming cycle



National initiatives

ADAPTATION PLANNING PROCESSES STATUS OF SUPPORT

65%
of approved proposals
are for LDC, SIDS &
countries in Africa

34%
of approved proposals
are for LDCs

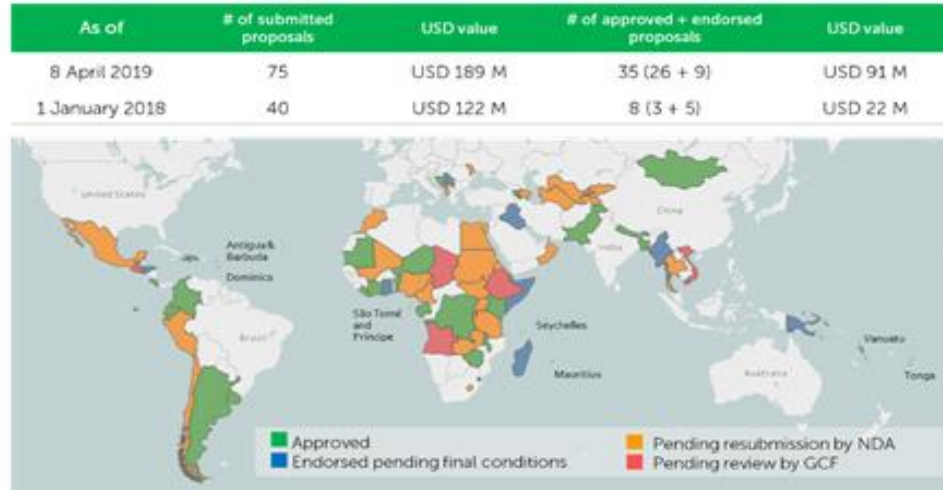


Figure: There has been a significant increase in the number of approved funding proposals from the developing countries since January 2018.



Subnational and local activities

- Impacts of climate change are directly felt at the sub-national/local level
- Local authorities are the first to receive the complaints/requests from the affected population
- Most adaptation actions will be deployed at the local level
- Adaptation measures have direct benefits for local population and ecosystems
- Sub-national/local development planning well suited to integrate adaptation

What types of approaches are being used in adaptation planning and implementation?

Adaptations employ a diverse portfolio of planning and practices that combine subsets of:

- Infrastructure and asset development
- Technological process optimization
- Institutional and behavioral change or reinforcement
- Integrated natural resources management (such as for watersheds and coastal zones)
- Financial services, including risk transfer
- Information systems to support early warning and proactive planning

Diverse Strategies and Mixed-Portfolio Approaches:

- Adaptation and Disaster Risk Management
- Adaptation and Development

Governance for Adaptation Planning and Implementation:

- Importance of Institutional Dimensions
- Institutional Barriers
- Facilitating More Effective Climate Adaptation Planning and Implementation
- Increasing Capabilities

Strategies so far

Governments and communities have begun implementing adaptation measures to mitigate climate change impacts

North America

Governments are engaging in adaptation planning at the municipal level. Adaptation measures are mainly to protect investments in energy and public infrastructure

Central, South America

Communities are following ecosystem-based adaptation measures by protecting natural areas. Farmers are resorting to resilient crops, climate forecasts and integrated management of water resources

The Arctic

Some communities have begun to deploy adaptive co-management strategies and communications infrastructure, combining traditional and scientific knowledge

Africa

Most are adopting disaster management measures, adjustments in technologies and infrastructure, ecosystem-based approaches and focusing on public health and livelihood diversification

Europe

Adaptation policy developed with focus on coastal and water management, environmental protection, land planning and disaster risk management

Australasia

Planning for sea-level rise as well as reduced water availability. Implementation, however, remains piecemeal

Asia

Mainstreaming climate adaptation action into national development planning, installing early warning systems, integrated water resources management, agroforestry and coastal reforestation of mangroves

Small Islands

Community-based adaptation has been shown to generate larger benefits when delivered in conjunction with other development activities

Oceans

Governments and users of the ocean are starting to facilitate adaptation to climate change. Though governance issues continue to pose the challenge

Source: Fifth Assessment Report of IPCC
Compiled by JYOTSNA SINGH
Graphics by RAJ KUMAR SINGH



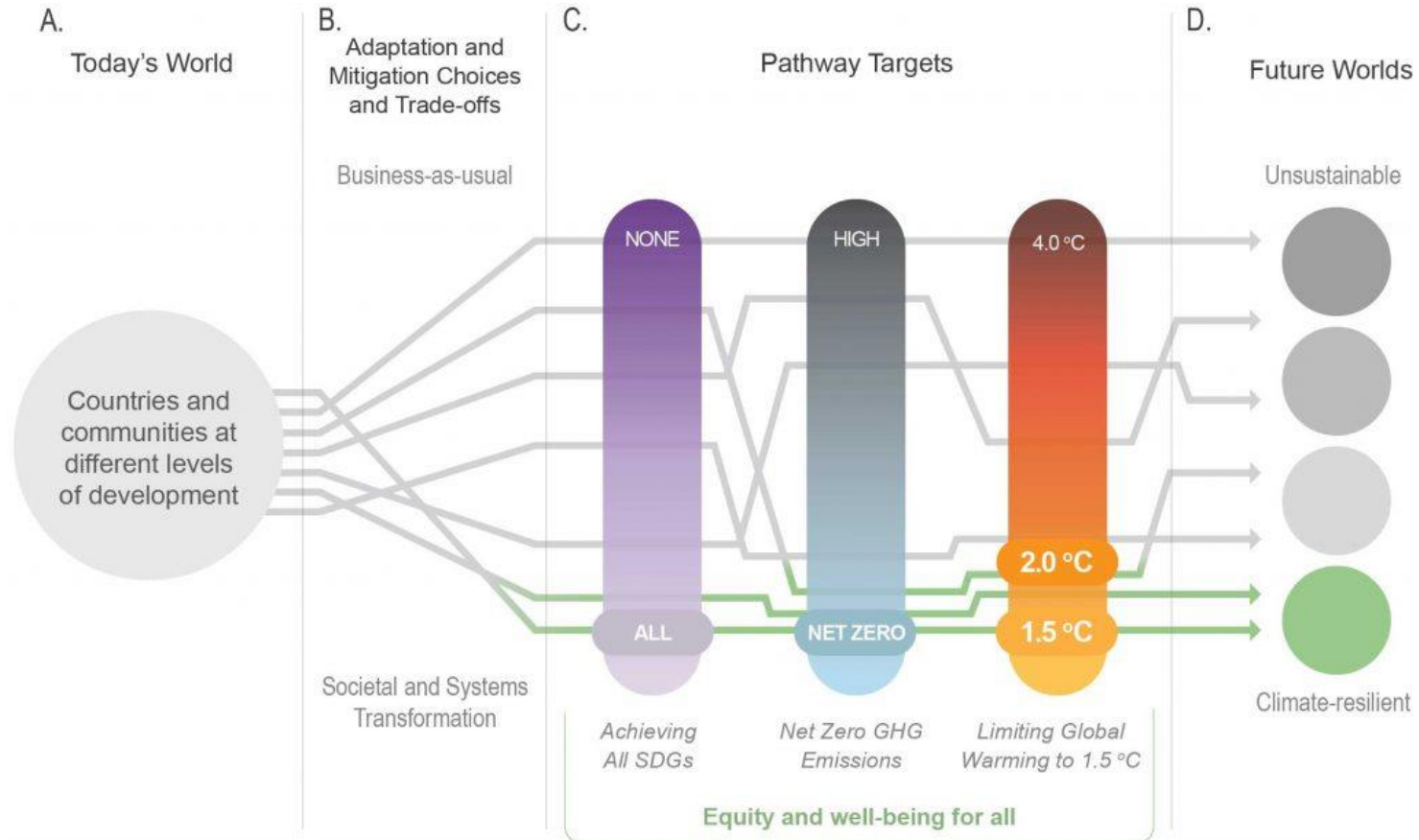


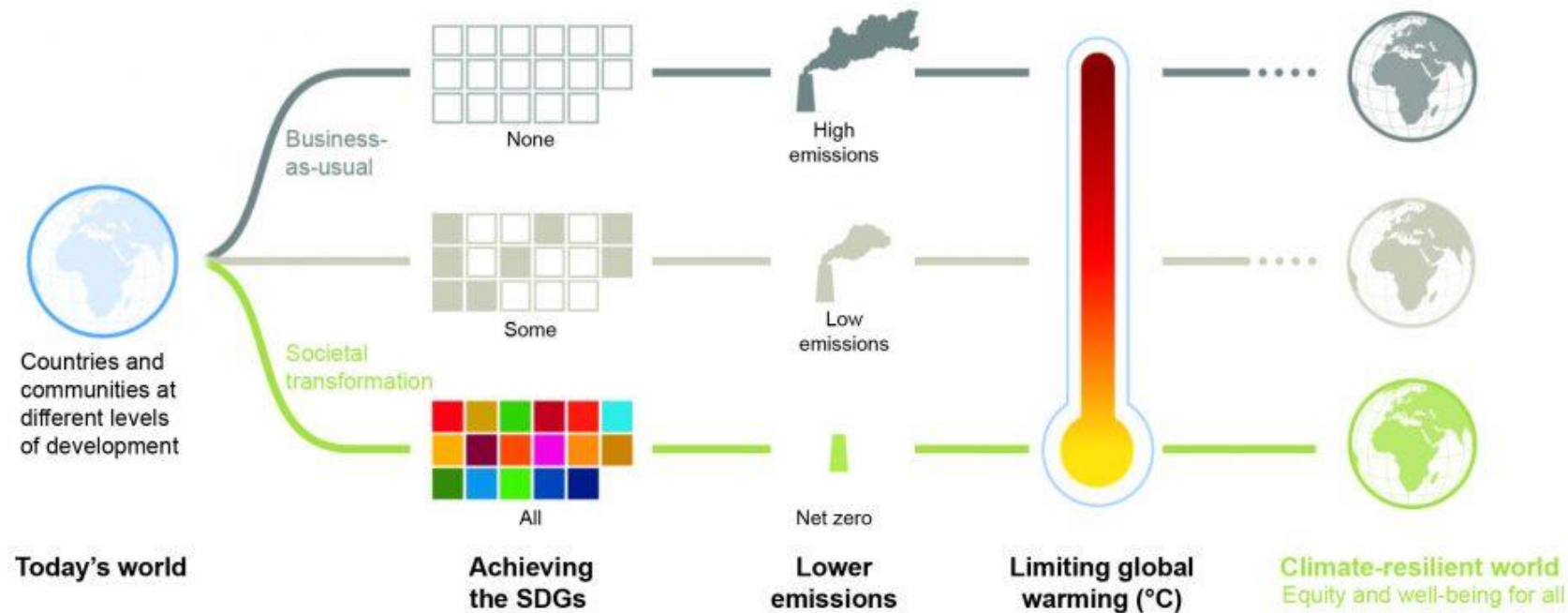
Figure: SR15 (https://www.ipcc.ch/sr15/graphics/#cid_3456)

What is a climate-resilient pathway for development?

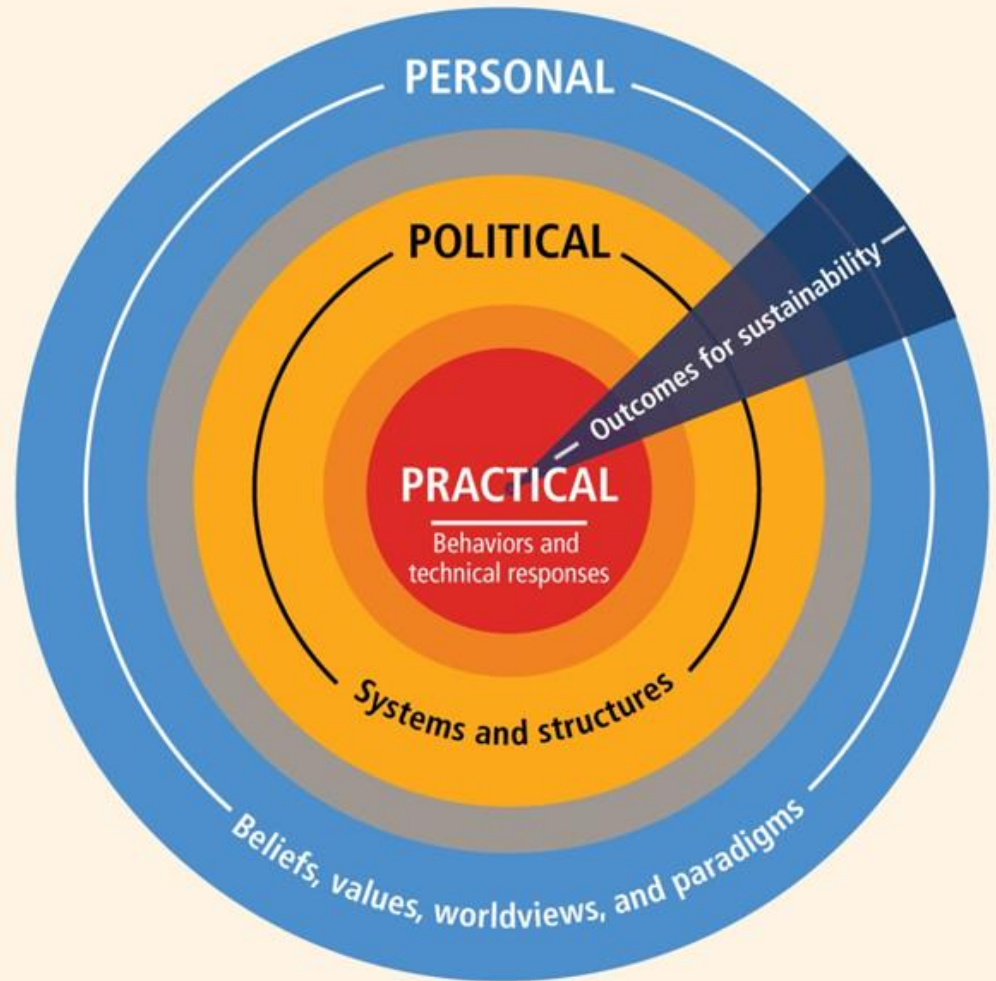
A climate-resilient pathway for development is a continuing process for managing changes in the climate and other driving forces affecting development, combining flexibility, innovativeness, and participative problem solving with effectiveness in mitigating and adapting to climate change. If effects of climate change are relatively severe, this process is likely to require considerations of transformational changes in threatened systems if development is to be sustained without major disruptions.

FAQ5.2: Climate-resilient development pathways

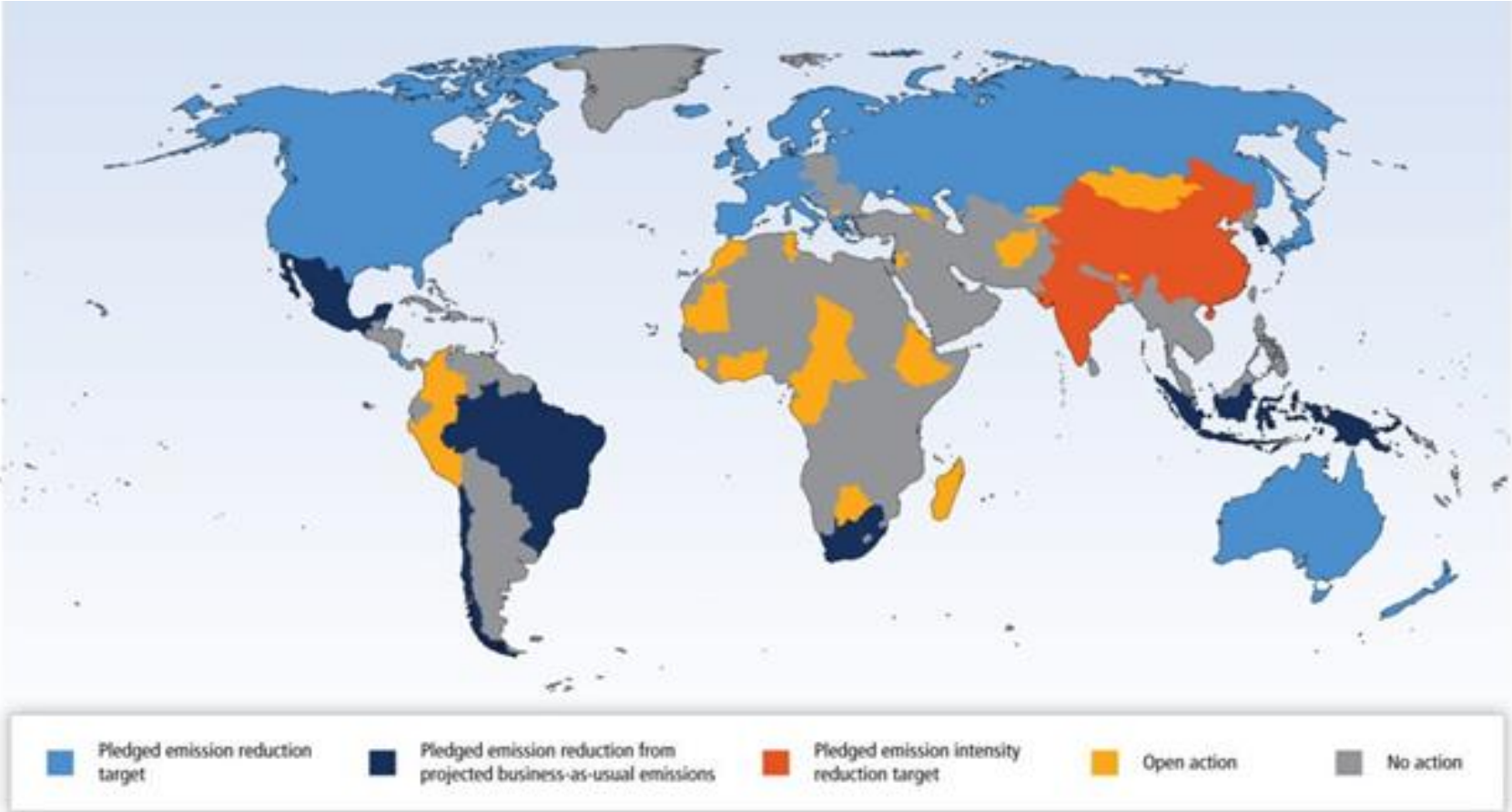
Decision-making that achieves the United Nation Sustainable Development Goals (SDGs), lowers greenhouse gas emissions, limits global warming and enables adaptation could help lead to a climate-resilient world.



The three spheres of transformation for promoting climate-resilient pathways for sustainable development

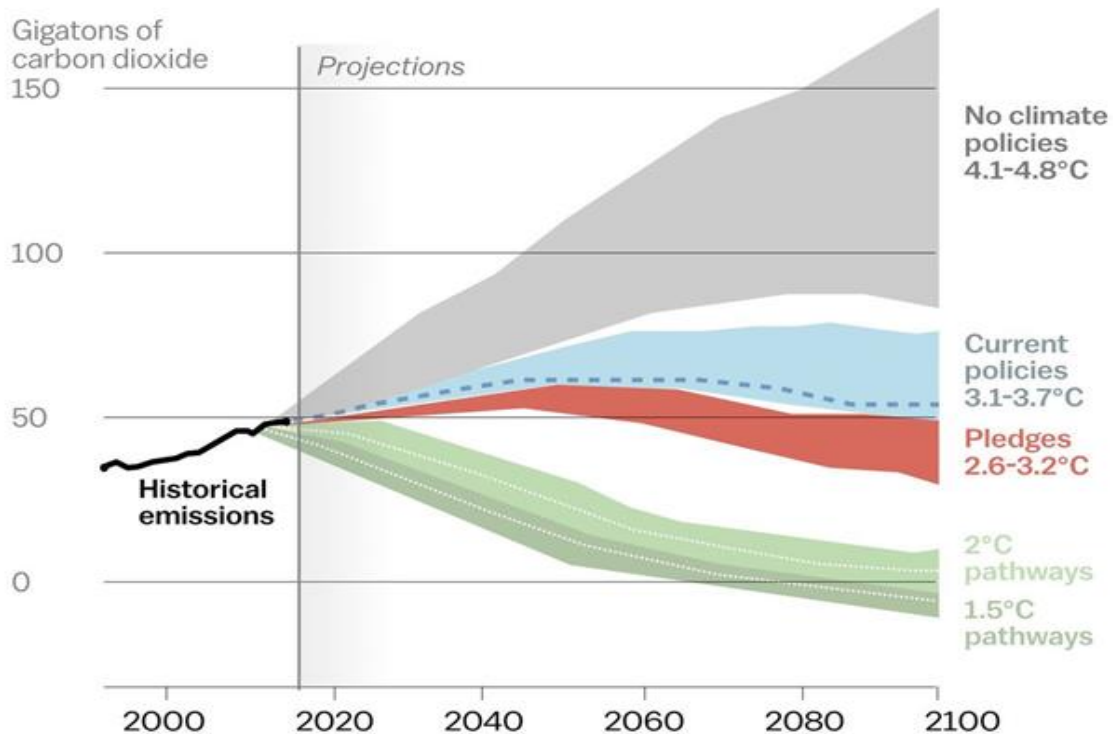


Climate adaptation and sustainable development



Effect of current pledges and policies

Global greenhouse gas emissions



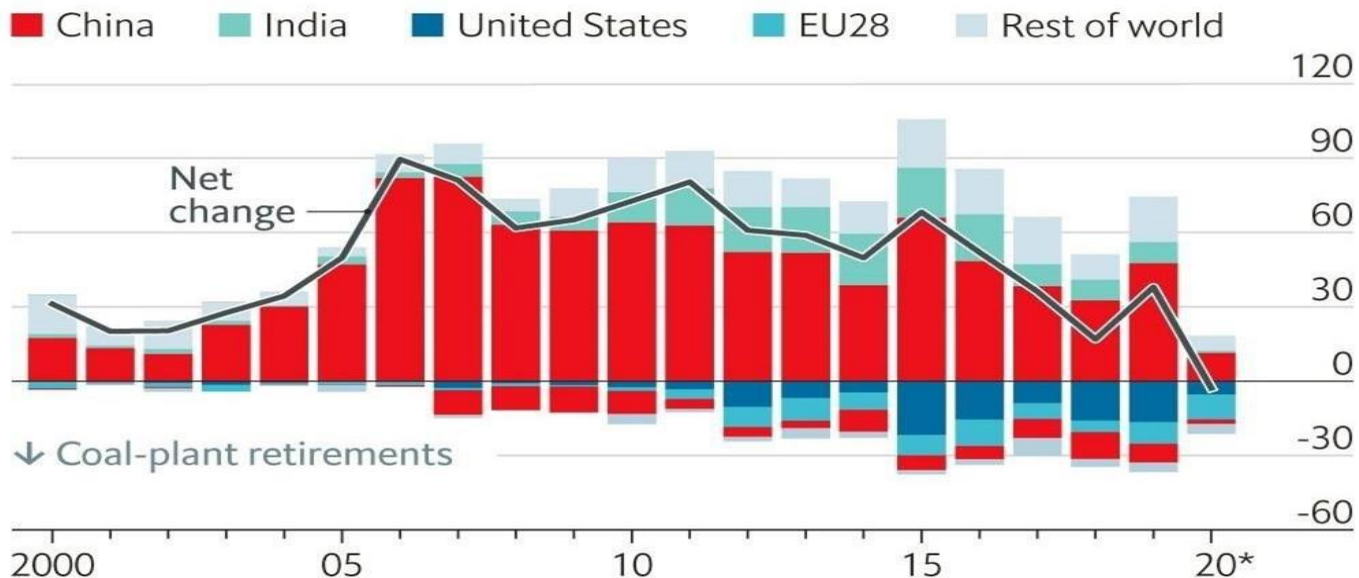
Source: Climate Action Tracker

Vox

The world is finally burning less coal

But it needs no use at all

Coal capacity, gigawatts

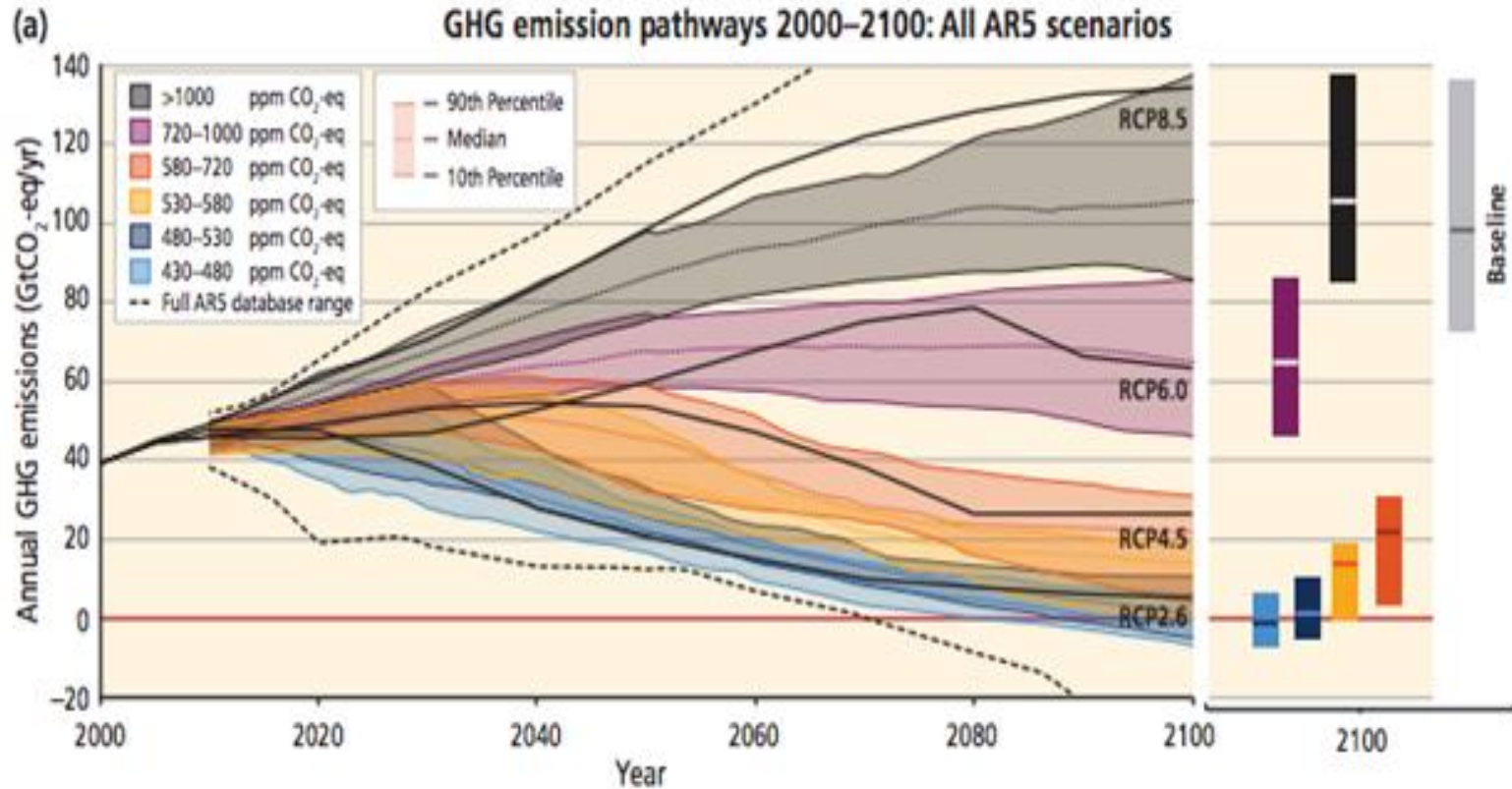


*H1

Source: Global Energy Monitor

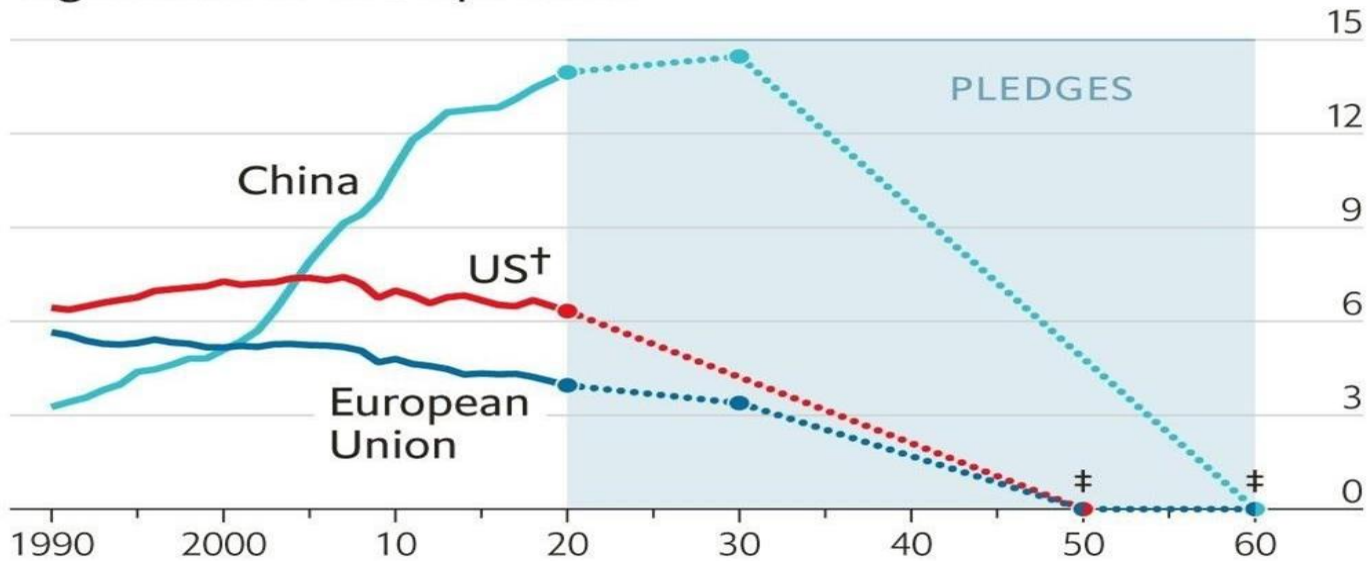
The Economist

Future Pathways for Adaption



Some of the world's largest economies have vowed to cut carbon emissions

Greenhouse-gas emissions*
Gigatonnes of CO₂ equivalent



*Excluding land use and forestry †Biden election pledge ‡Net zero

Source: Climate Action Tracker

The Economist

Adaptation opportunities, constraints and limits

Brief definitions

Opportunities

Constraints

Limits

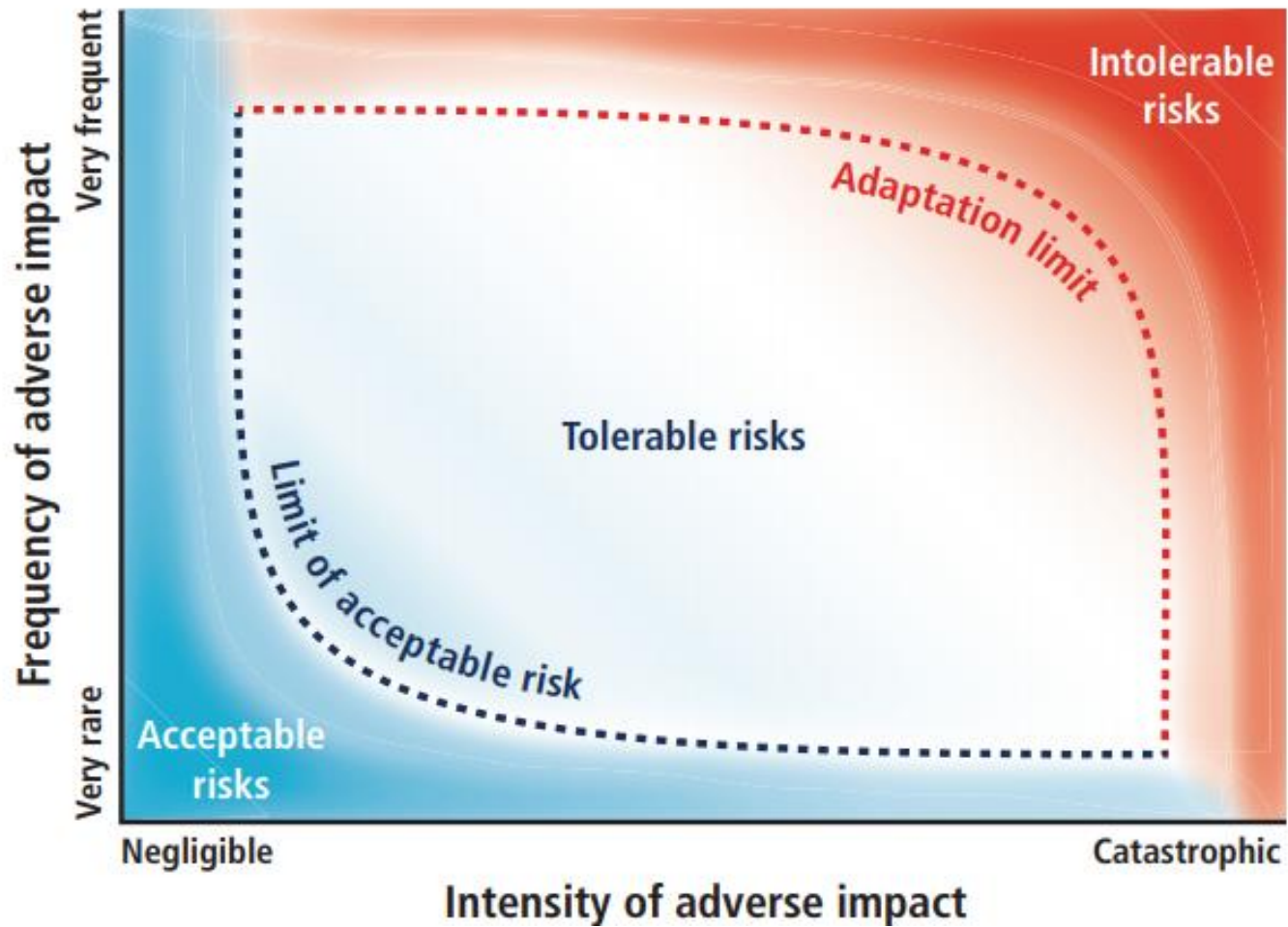
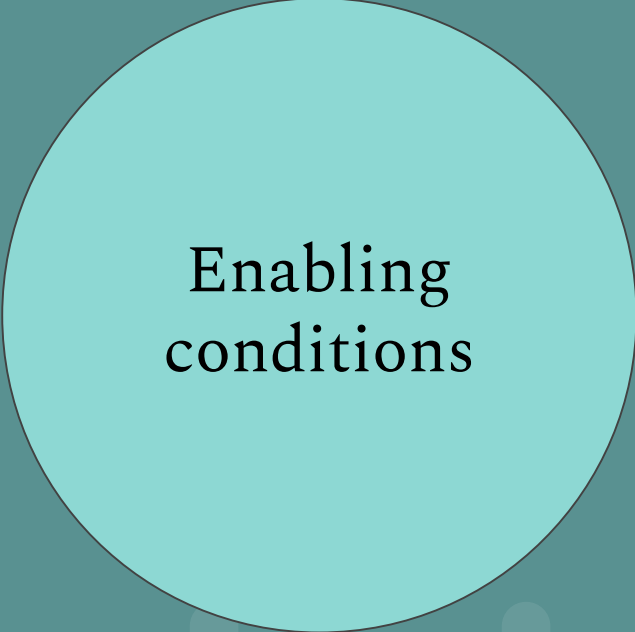


Figure: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap16_FINAL.pdf

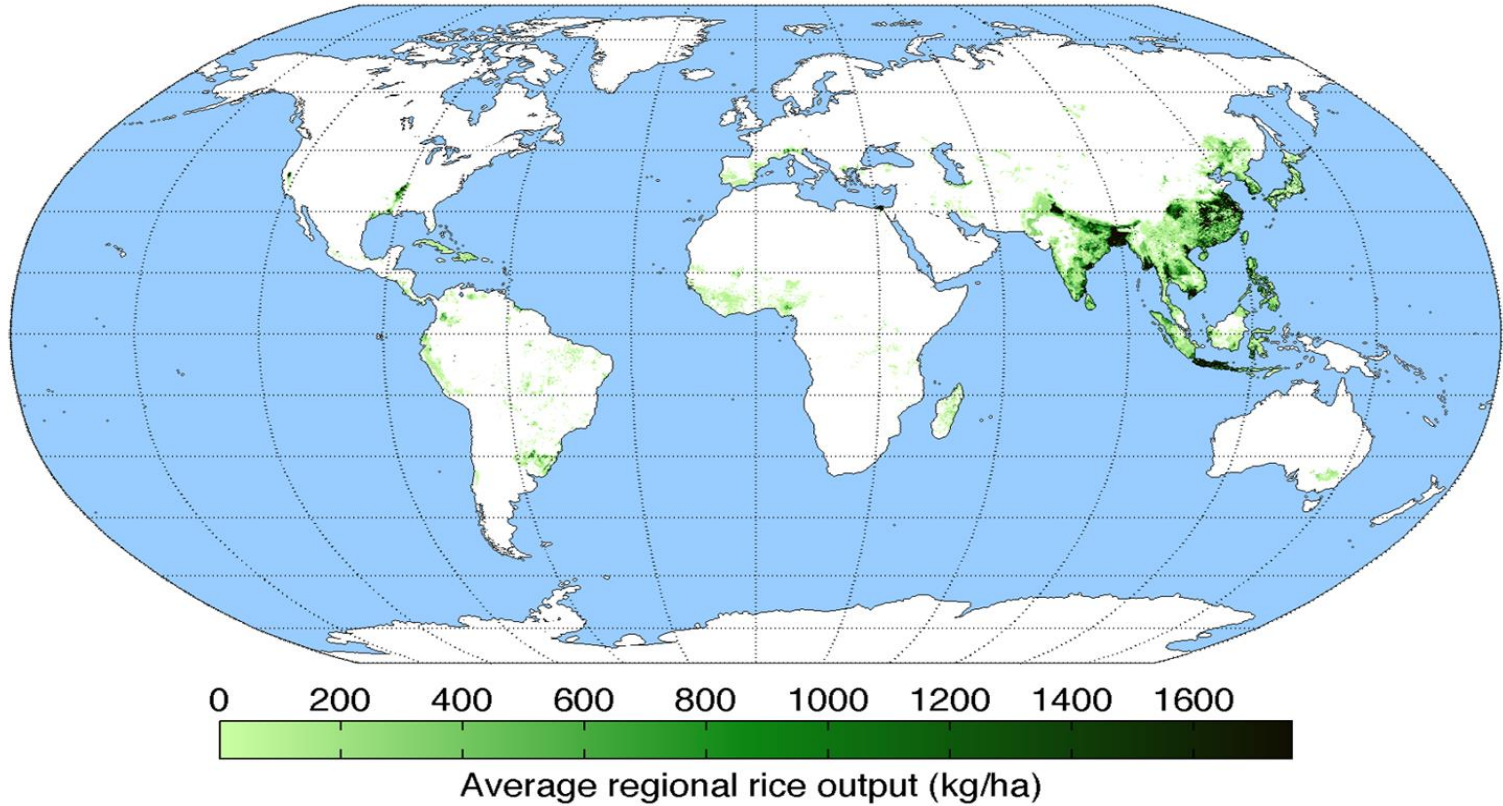
Adaptation opportunities



Enabling
conditions

Create an enabling environment including national/sub-national/sectoral policy framework, domestic technical expertise, financing channels and administrative procedures

Rice example in Asia

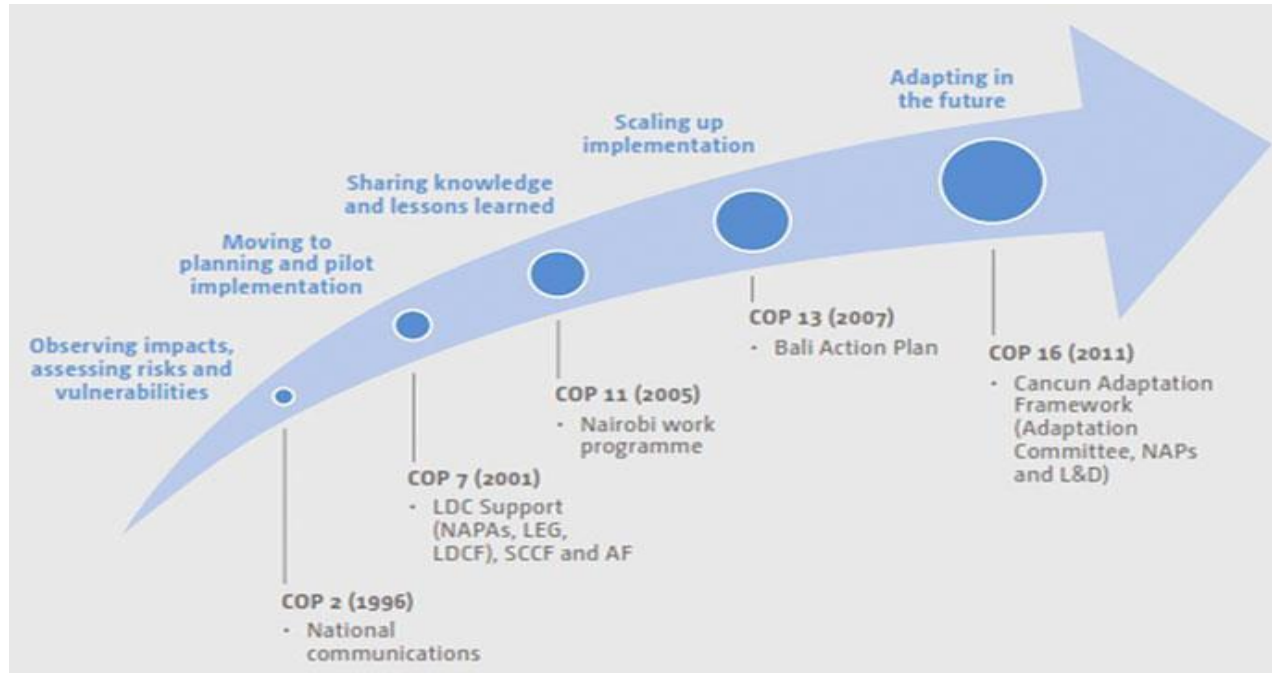


Identification of key adaptation opportunities

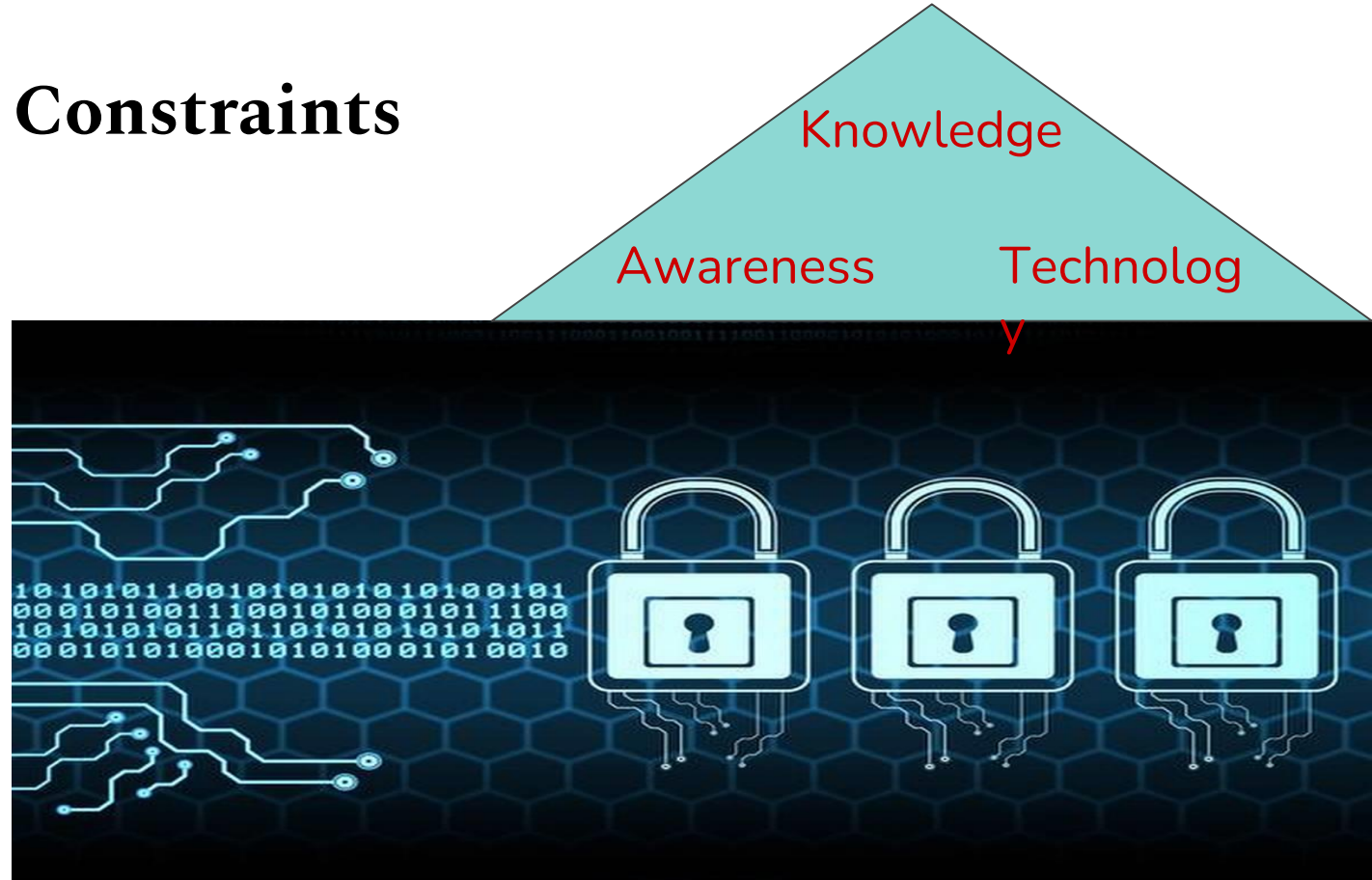


A Case Study : Bangladesh

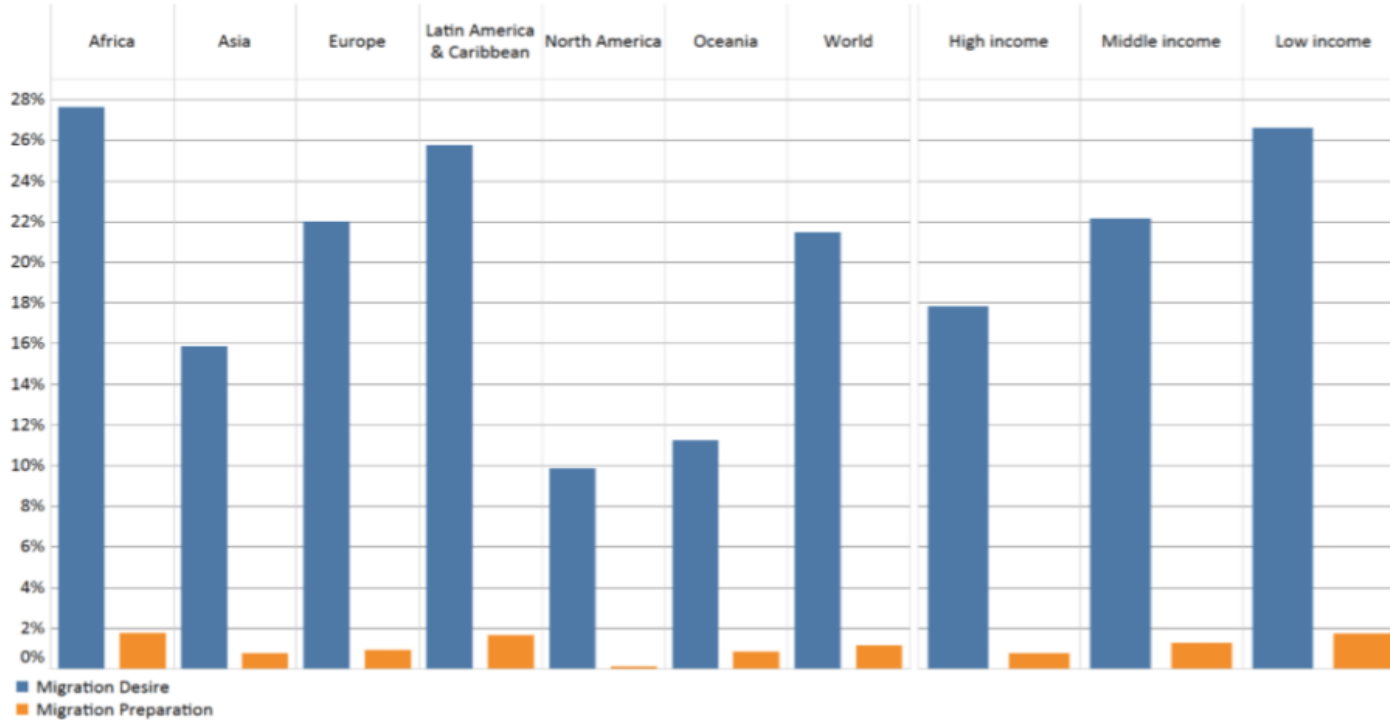
National adaptation plan



Adaptation Constraints



Physical Constraints



Types of environmental degradation

Biological Constraints

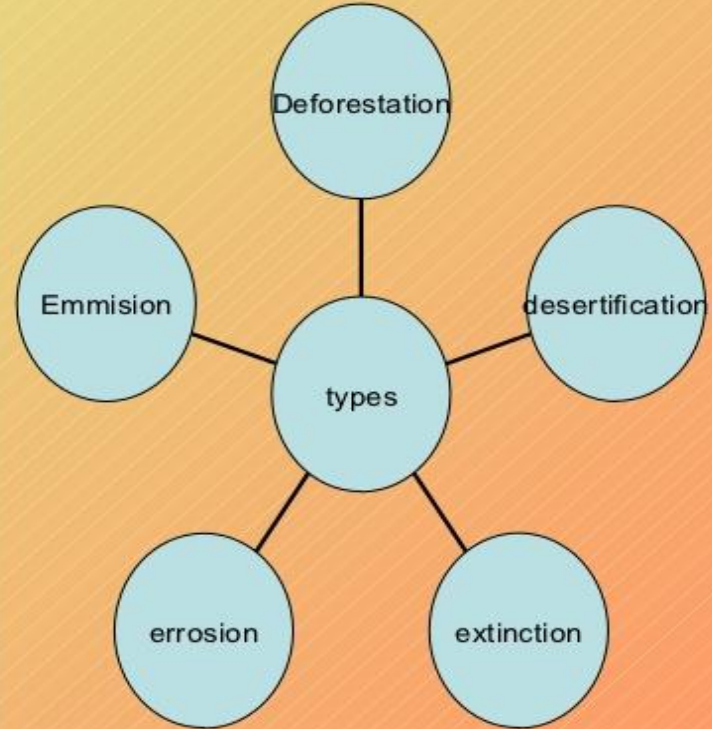
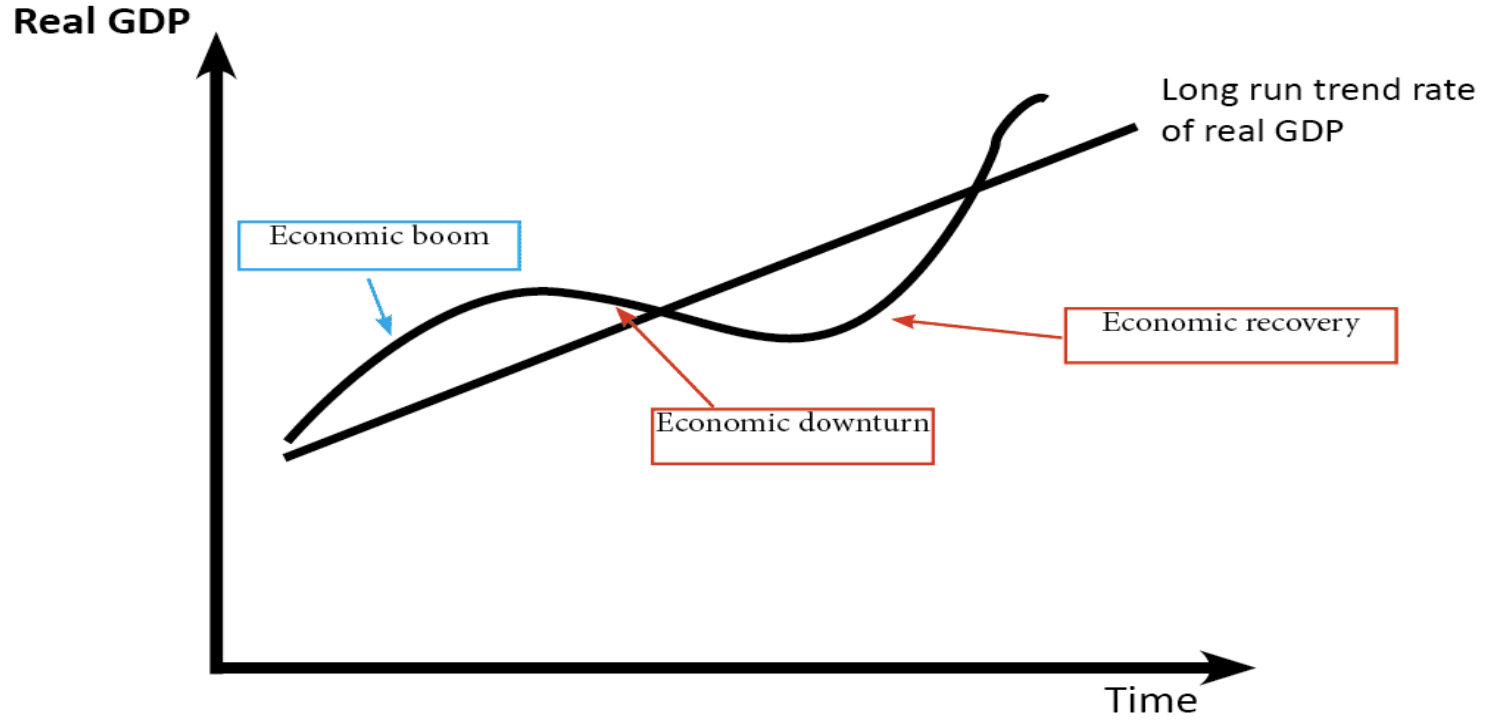
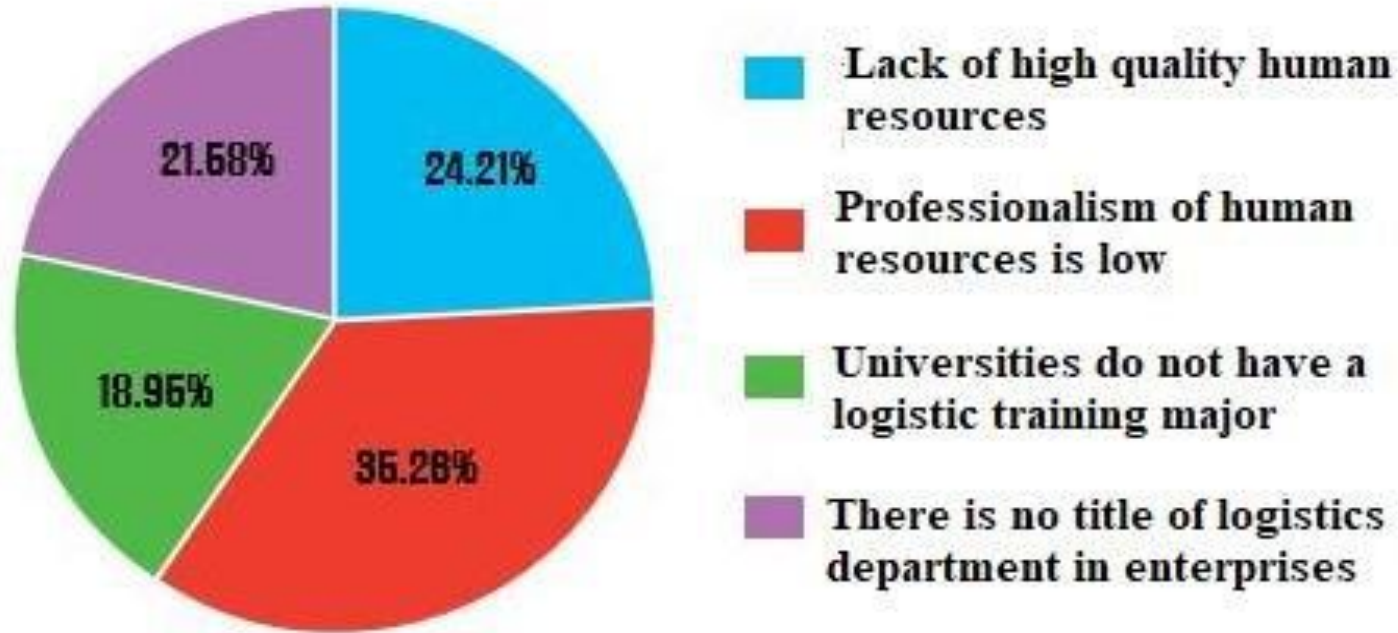


Figure:<https://images.app.goo.gl/EMHVBf87maK4oA1KA>

Economic Constraints



Human Resource Constraints



Living with Climate Change

Are there Limits to Adaptation?



Tyndall°Centre
for Climate Change Research

PLAN
Klimetilpassning i Norge

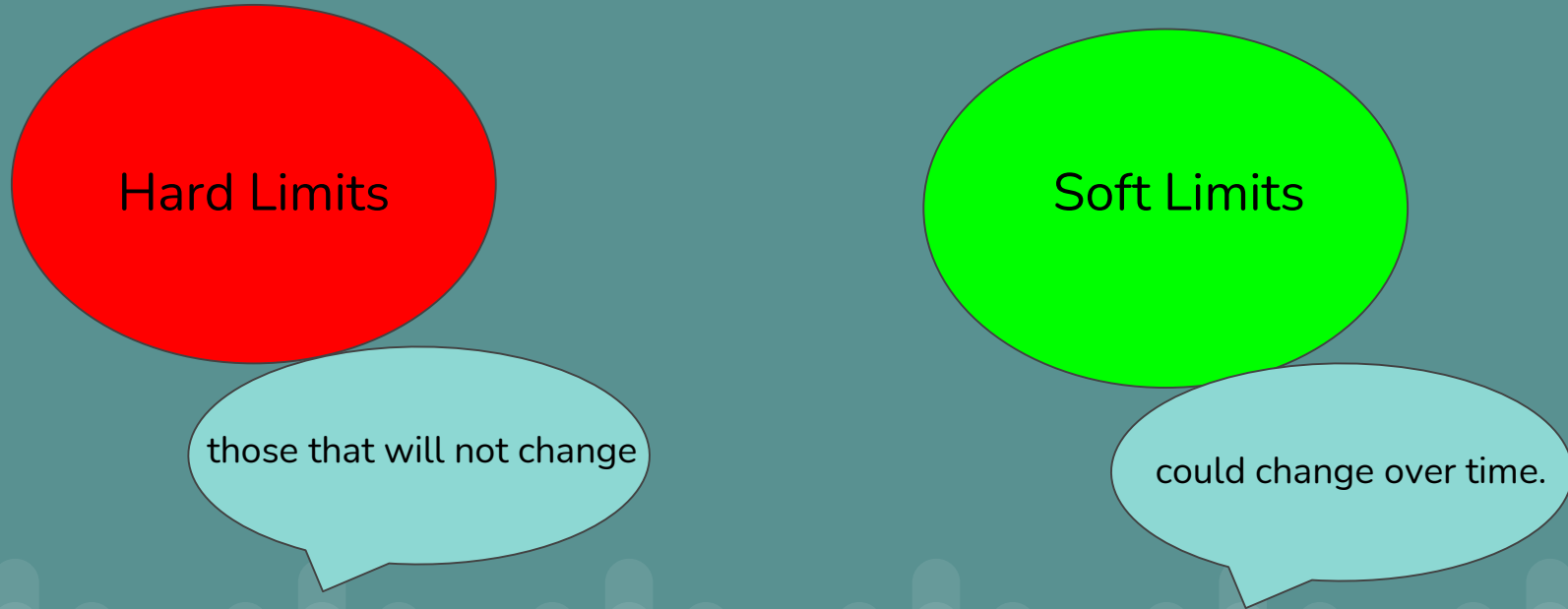


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





















































































GECHS
GLOBAL ENVIRONMENTAL CHANGE
AND HUMAN SECURITY


























































































Hard VS Soft Limits



Sectoral Synthesis

Sectors			
Sectors (chapter)	Opportunities	Constraints	Limits
Freshwater (3)	     	      	
Terrestrial (4)	   	    	
Coastal (5)	    	      	 
Ocean systems (6)	  	   	
Food systems (7)	     	     	 
Urban areas (8)	     	      	 
Rural areas (9)	     	     	 
Human health (11)	    	    	  
Human security (12)	 	    	 

Regional Synthesis

Regions			
Regions (chapter)	Opportunities	Constraints	Limits
Africa (22)	     	     	 
Europe (23)	   	  	  
Asia (24)	  	   	
Australasia (25)	   	    	 
North America (26)	  	     	
Central & South America (27)	  	     	
Polar regions (28)	  	   	
Small islands (29)	    	      	
Open oceans (30)	   	 	

Economics of adaptation

The background is a solid orange color. In the upper right quadrant, there are several overlapping circular shapes of varying sizes and opacities, some containing faint, stylized patterns. These shapes are positioned in the top right corner, partially overlapping the main text area.

Adaptation actions



autonomous

private actors



planned

public actors
private actors



natural

Gains?



Adaptation strategies and their actors

- Altered patterns of enterprise management, facility investment, enterprise choice, or resource use (**mainly private**)
- Direct capital investments in public infrastructure (e.g., dams and water management—**mainly public**)
- Technology development through research (e.g., development of crop varieties—**private and public**)
- Creation and dissemination of adaptation information (through extension or other communication vehicles—**mainly public**)
- Human capital enhancement (e.g., investment in education— **private and public**)
- Redesign or development of adaptation institutions (e.g., altered forms of insurance—**private and public**)
- Changes in norms and regulations to facilitate autonomous actions(e.g., altered building codes, technical standards, regulation of grids/networks/utilities, environmental regulations—**mainly public**)
- Changes in individual behavior (**private, with possible public incentives**)
- Emergency response procedures and crisis management (**mainly public**).

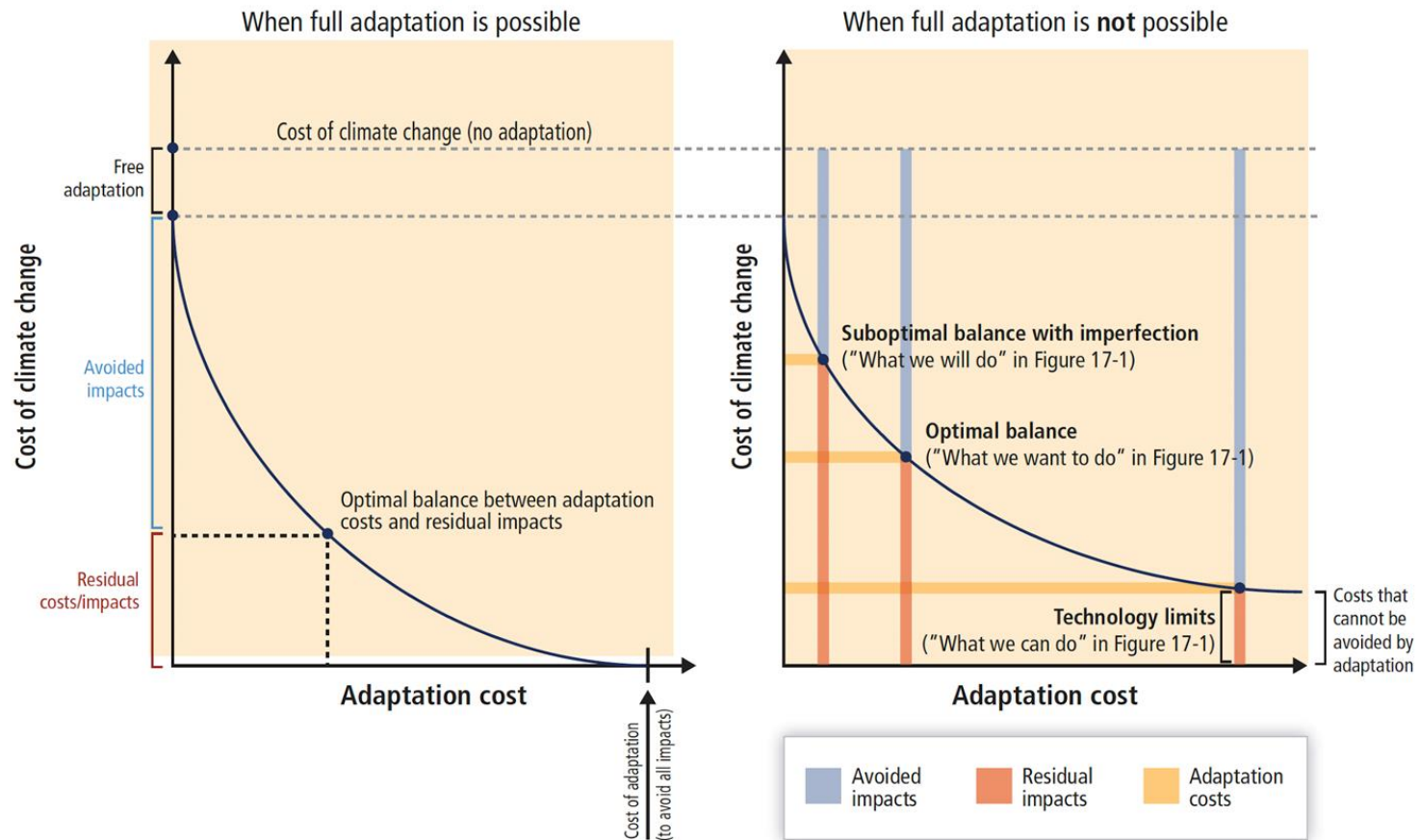
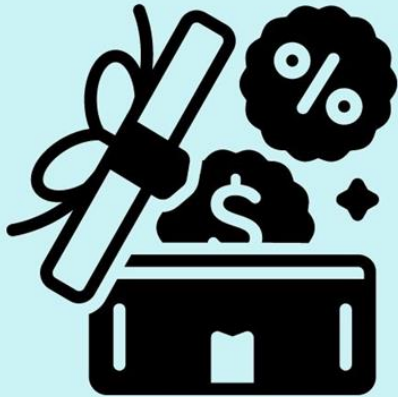


Figure 17-2 | Graphical representation of link between the cost of adaptation (on the x-axis) and the residual cost of climate change (on the y-axis). The left panel represents a case where full adaptation is possible, while the right panel represents a case in which there are unavoidable residual costs.



Adaptation benefits

reduction in damages + any gains in climate-related welfare

Adaptation costs

cost of any additional investment needed to adapt to or exploit future climate change



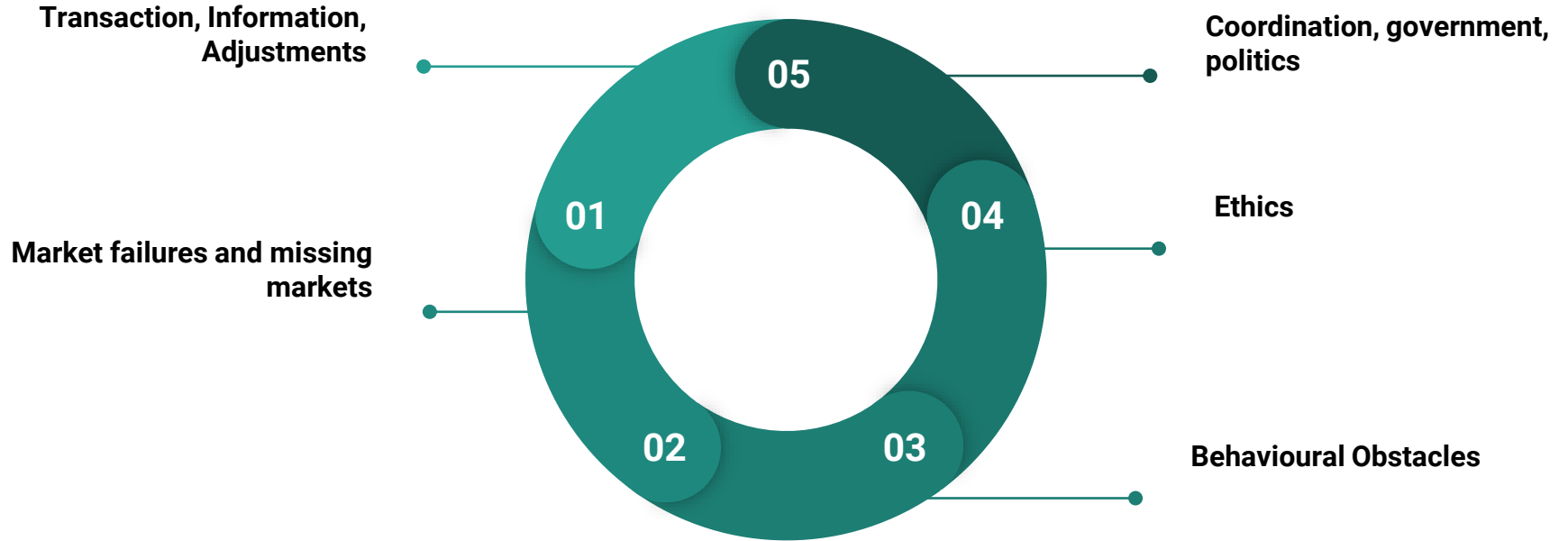
Standard economic accounting?

items affected: income distribution,
poverty, employment, ecosystem,
health, social organization, cultural
practices

MONETIZATION?



Economic Barriers to Adaptation Decision Making



Costs of



transaction



information



adjustments

accessing markets
and information

public good

cost
incurred while
learning new
climate conditions



Market failures

externalities (adaptation actions by one household, firm, or even country may create higher damages for others)

information asymmetry

moral hazards



Governments

Governments and local authorities face their own barriers:

- government and local authority decision makers have their own barriers: cognitive and behavioral biases; moral hazard,
- insufficient resources or limited adaptation capacity
- coordination failures within the government
- driven by narrow interest groups (multi-stakeholder approach)



Behavioural obstacles

time inconsistent decisions, favor
status quo, value profits and losses
differently, prefer familiar choices

Ethics and distribution

- not all able to afford adaptation
- differences in levels of acceptable risk
- justice and fairness

**NET BENEFIT AND IMPACT
ON EQUITY**



Economics' contribution to adaptation decision making



Cost-Benefit Analysis under uncertainty applied to adaptation



uses subjective probabilities for different climate futures



MONETARY ITEMS

Difficult valuation of non-market impact



TIMING

The possibility to delay action until more information is available; Real option technics as extension.



Multi-Metric Decision Making

- can include full range of social, environmental, technical, economic criteria
- applied to issues concerning: urban flood risk, agricultural vulnerability,
- suggested by the United Nations Framework Convention on Climate Change for assesment in developing countries

*Non-
Probabilistic
Methodologies*



Scenario-based analyses



maxi-min



"robustness"

Incentives



Risk Sharing, Risk
Transfer, Insurance



Payments for
Environmental Services

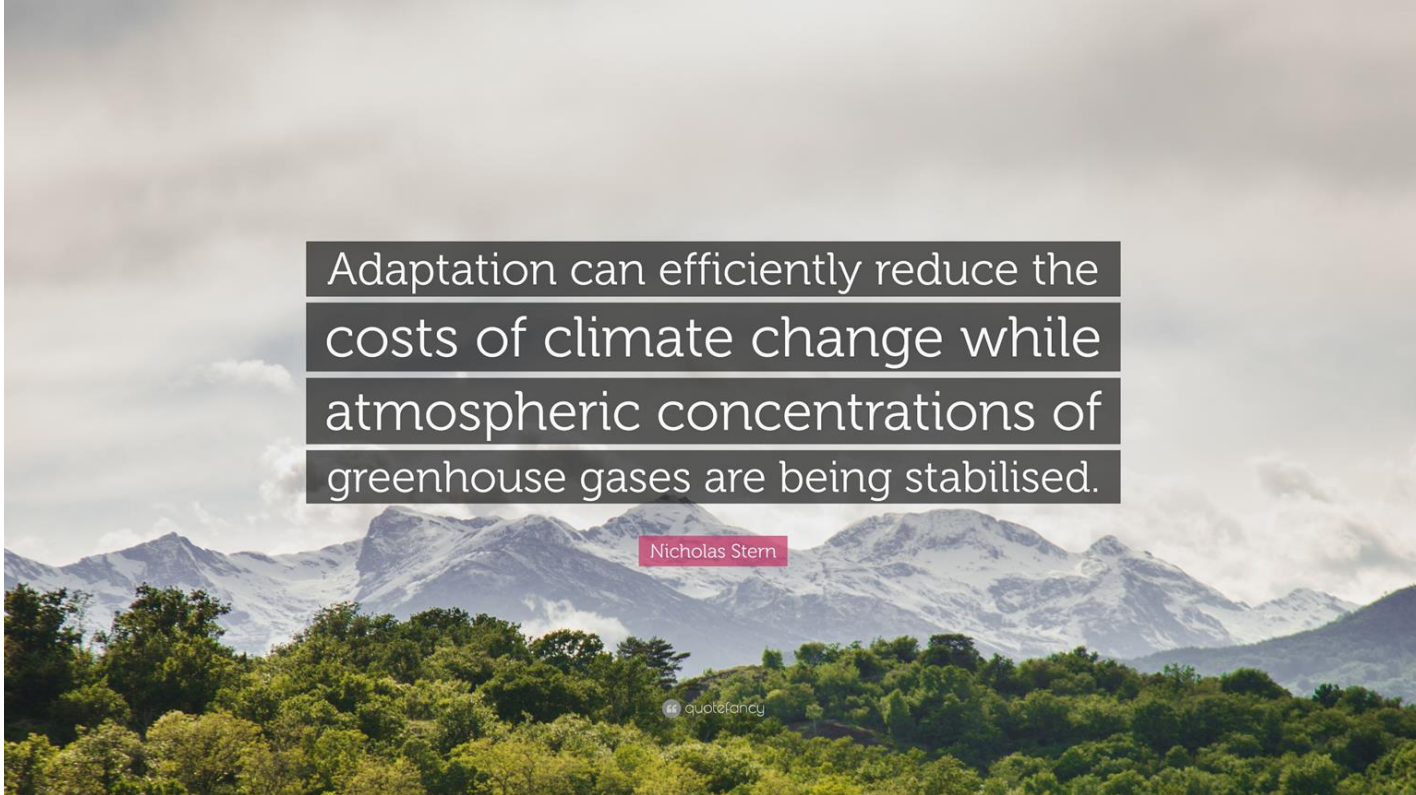


Charges, Subsidies,
Taxes

Water Markets

Intellectual Property
Rights

Summary:



Adaptation can efficiently reduce the costs of climate change while atmospheric concentrations of greenhouse gases are being stabilised.

Nicholas Stern

quotefancy



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**Thank you
for your attention**

