The 10th IEEJ/APERC International Energy Symposium

Role of Adaptation in Climate Change Response

30 May 2025

Nobuo Mimura
Ibaraki University

Contents

1. Introduction to Adaptation

2. Adaptation Options and Innovation Potential
   (1) Disaster risk management
   (2) Agriculture
   (3) Nature-based Solution
   (4) City Innovation

3. Global Landscape of CC Adaptation

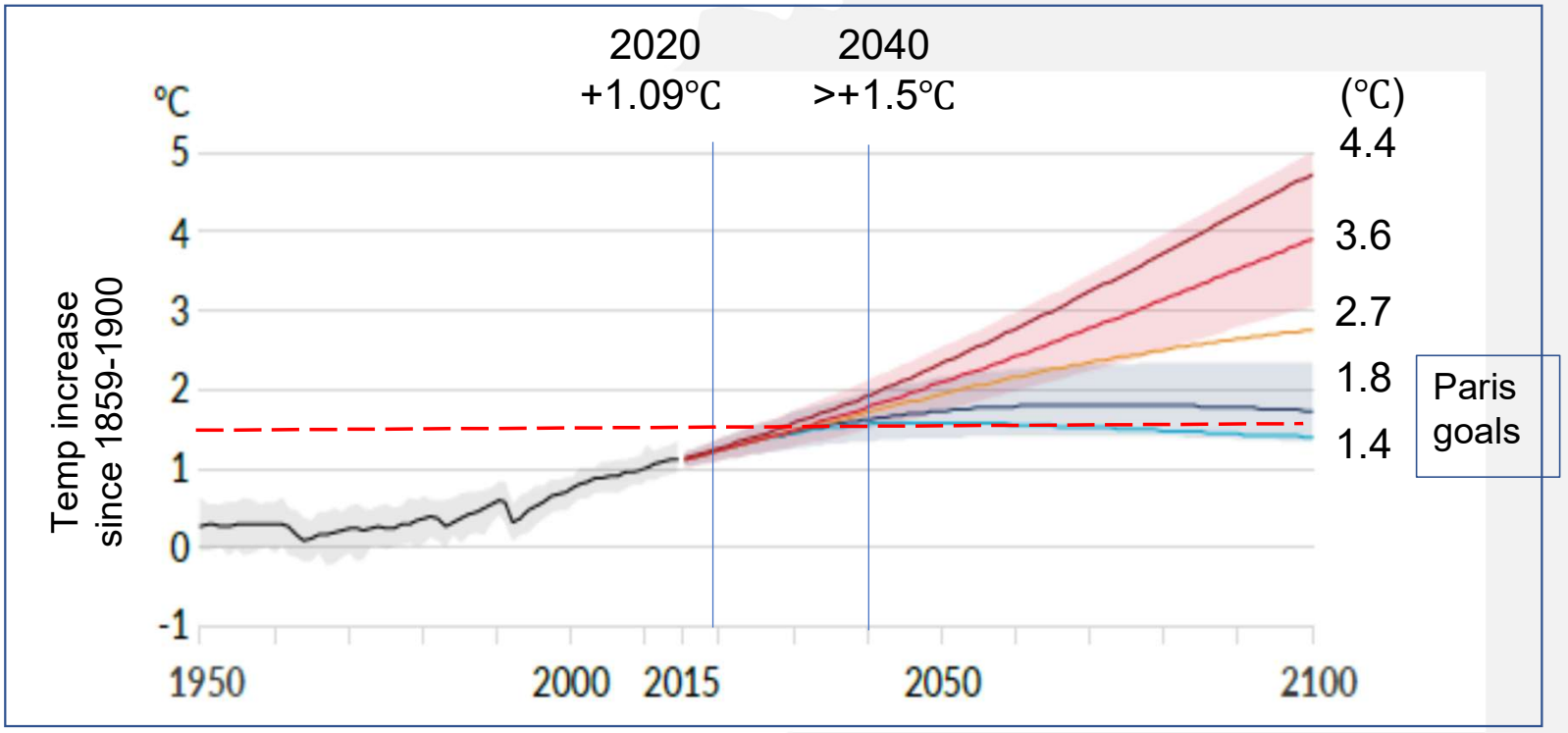
Summary

Projection of Global Warming (IPCC WGI, 2021)

Gaps of Ideals and Realities!

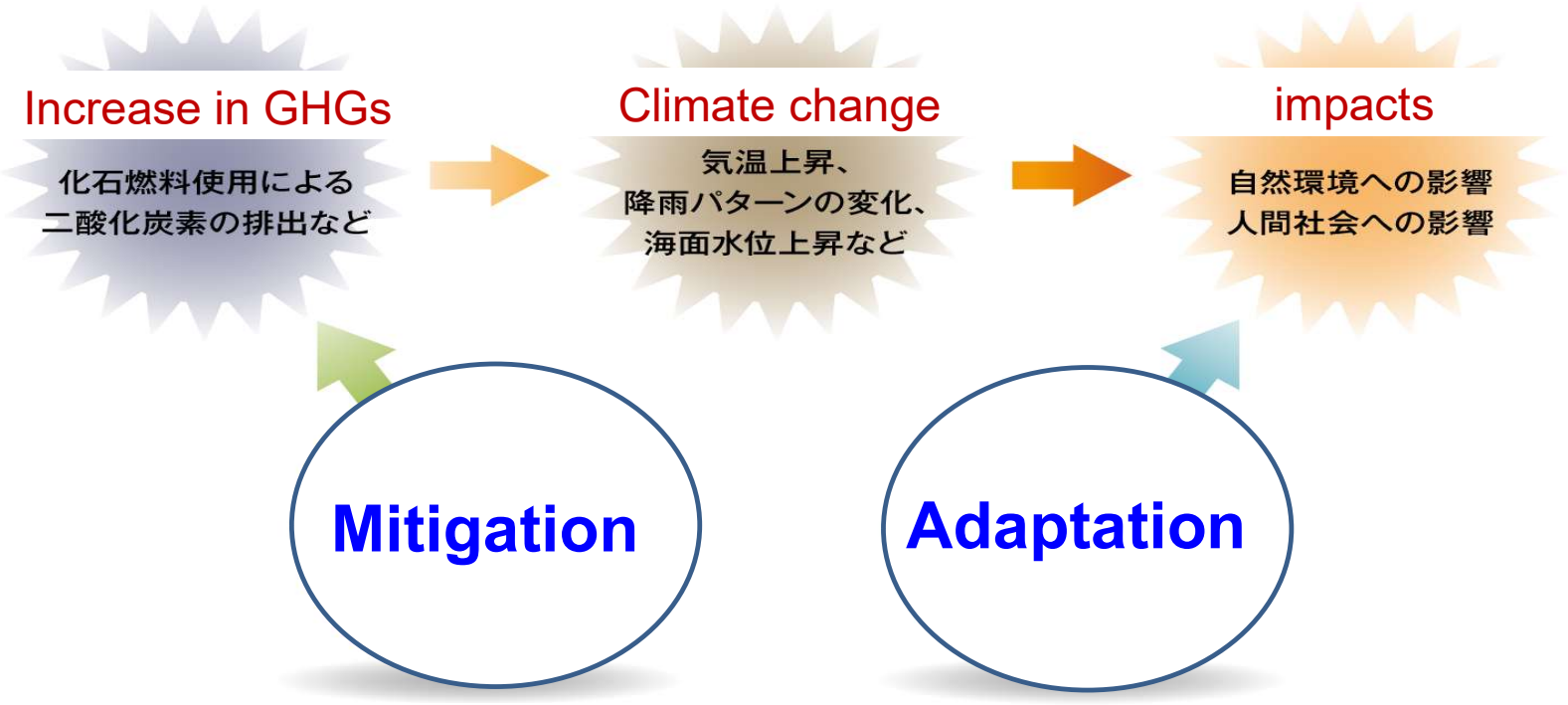
- Global mean temperature will likely reach 1.5℃ increase around 2040 or earlier.
- We are not on track to limit warming to 1.5℃.

How to respond to this situation?



Source : IPCCAR6 SPM WG Report,2021

What is CC Adaptation? What Roles?



Reduce GHGs emissions

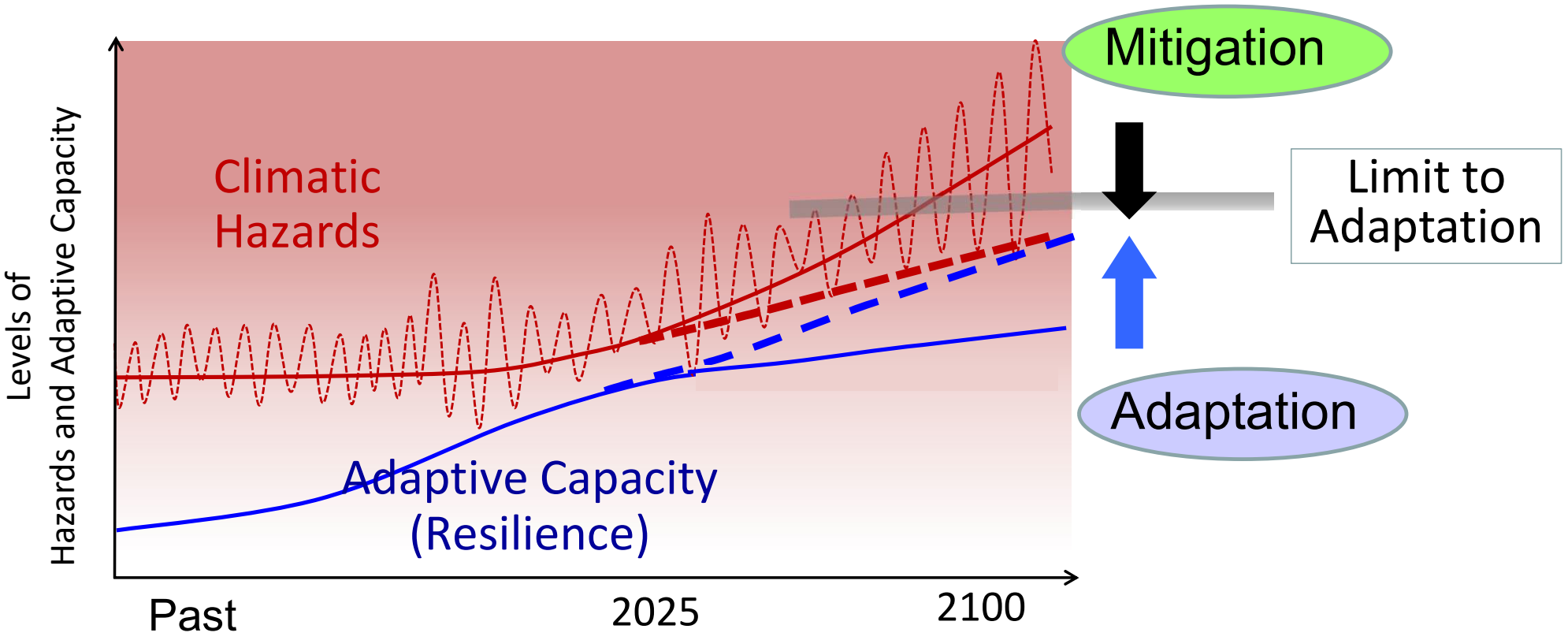
- Renewable energy
- Industry
- Transportation
- Lifestyle

Minimize adverse impacts/utilize benefits

- Disaster prevention
- Agriculture/ Foods
- Human health
- Water resource etc

(MOEJ HP, 2024)

Roles of Mitigation and Adaptation

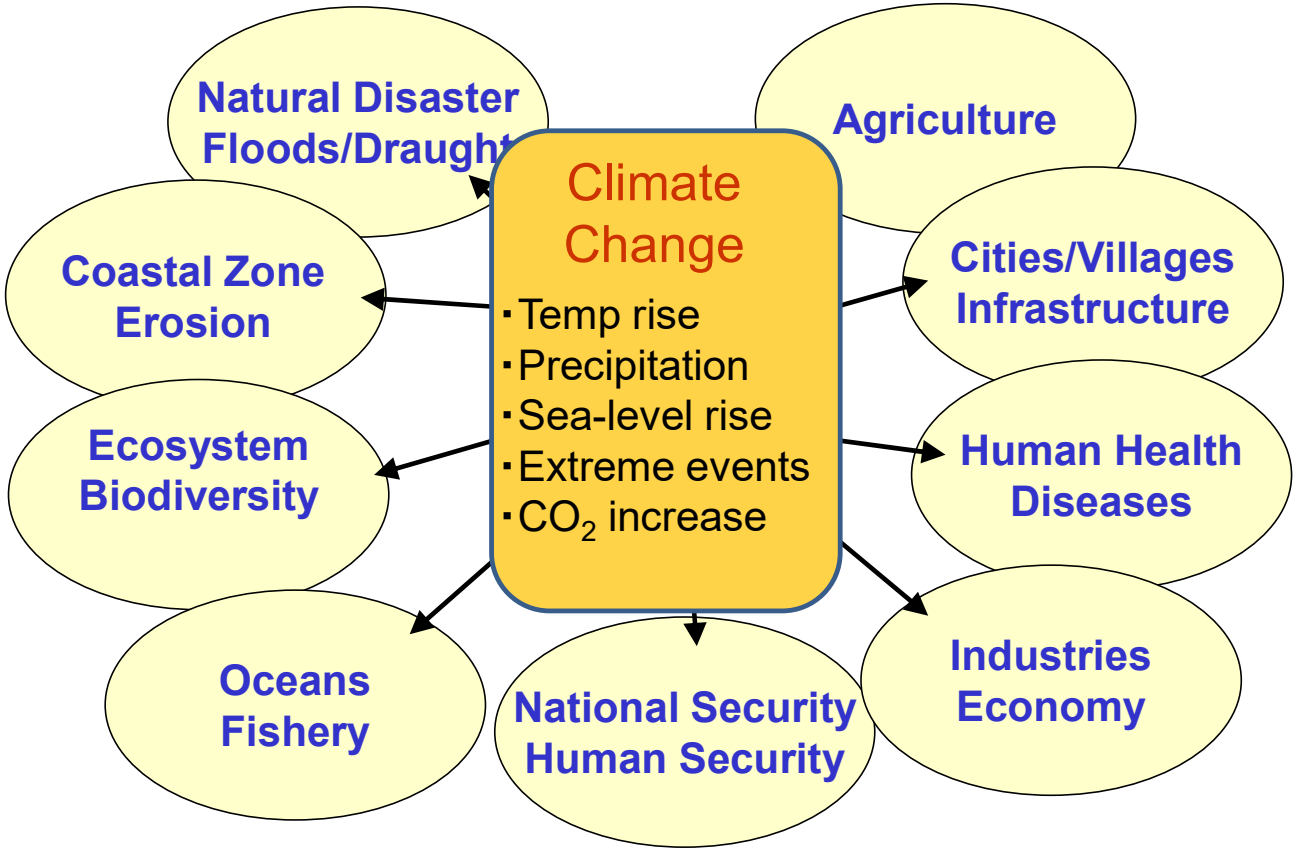


- Mitigation and adaptation play complementary roles in reducing the CC risks.
- Since both society and natural systems have limits to adapt, mitigation must restrict climate change to within these limits.

(Revised from Prof. Komatsu, Kyushu U.)

Which Sectors need Adaptation?

- Impacts appear over most sectors of natural and human systems.



Seven Sectors in Japan's National Adaptation Plan

- Agriculture, Forestry, Fisheries
- Water Environment, Water Resources
- Natural Ecosystems
- Natural Disasters, Coastal Zones
- Human Health
- Industry, Economy
- Life of the Citizens, Urban Life

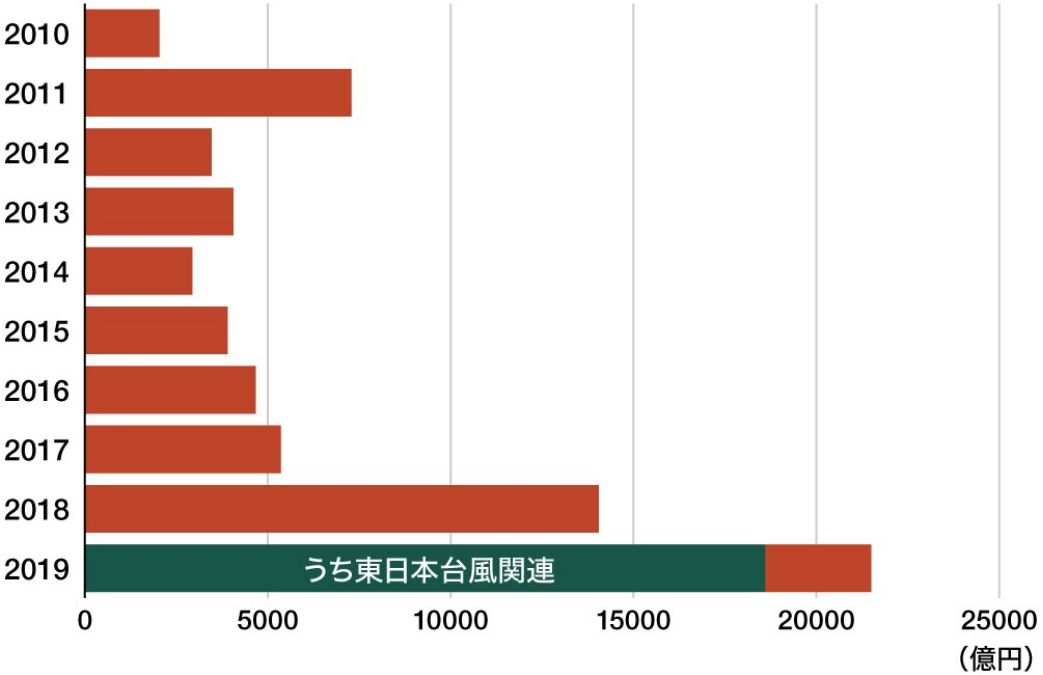
What are Adaptation Options?

- Wide range of options
- Combination of measures suitable for the context of sectors and localities

Category	Type	Examples
Physical	**Infrastructure**	Dike, Reservoir, Heat Shelter
	Technology	Monitoring, Early warning, Water res. diversification
	Ecosystem-based	Wetland conservation, Forest protection, Green infrastructure, Ecosystem networking
	Social service	Safety nets, Health care/insurance
Institutional	**Law/Regulation**	DRM, City planning
	Policy	Adaptation planning, Scientific information
Economic	**Economic**	Tax/subsidies, CC Insurance, Redundant paths
Social	**Education**	Knowledge on CC, Traditional knowledge
	Information	CC information, Hazard maps, Workshop
	Behavior change	Evacuation practice, Change in varieties and practices, Lifestyle change, migration

(1) Adaptation in Disaster Risk Management

Damages of water disasters for the past 10 years (except tsunami)



国土交通省まとめ

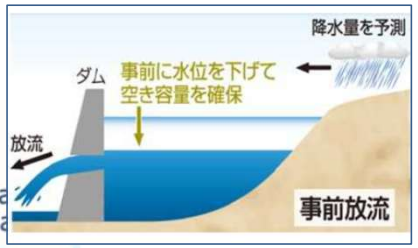
nippon.com

Source: MLIT, Hiroshima Pref., :J-Cast News

New Watershed Management:
“River Basin Disaster Resilience and Sustainability by All”

Prevention

- River flood control
- Dams
- Forest Management
- Rain water storage



Mitigation

- Monitoring
- Early warming/ evacuetion
- Evacuation shelter
- Support to victims
- Recovery & reconstruction

Effectiveness of Mitigation and Adaptation to Reduce Floods Damage

S18-3-3
Prof. Kazama, Tohoku U

Adaptation options

Smit *et al.*,(1999)

防護
protect

Flood control
河川整備計画達成

Pumping capacity
1/10内水排水達成

順応
accommodate

Pilotis houses
10000人/km²以上＆1/30で0.5m以上に水深5mまで被害無し

Paddy dam
全てのたんぼに貯留効効果

撤退
retreat

Land use control
10000人/km²以下&1/200で水深3m以上は移転

Mitigation options

GHG control

Difference of 4℃ and 2℃ impacts

Flood Damage Reduction by Mitigation and Adaptation

	Option	Reduction Rate of Economic impact
Mitigation	From 4℃ to 2℃	- 22%
Adaptation	Flood control	- 14%
	Pumping capacity	- 26%
	Land use control	-24%
	Pilotis houses	- 68%
	Paddy dam	- 7%

- Integration of mitigation and adaptation is crucial to manage the risk of climate change.

（after Prof. Kazama, Tohoku u., 2022）

(2) Adaptation in Agriculture

■ Technologies

- Heat-tolerant crop varieties
- Cultivation method, irrigation
- Pests, diseases, damage by birds and wild animals
- ICT and drones

■ Utilizing Opportunities

- Expanding production areas to higher-latitude regions
- Subtropical and tropical crops.
- Expanding the cultivation period and areas

■ Collaboration of Stakeholders

- Promoting locally-led adaptation
- Implementation of adaptation through collaboration between national, local governments and stakeholders

Heat-Tolerant Rice Varieties

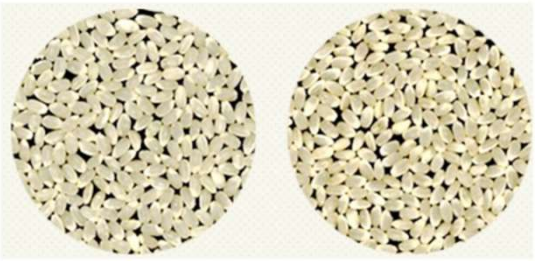
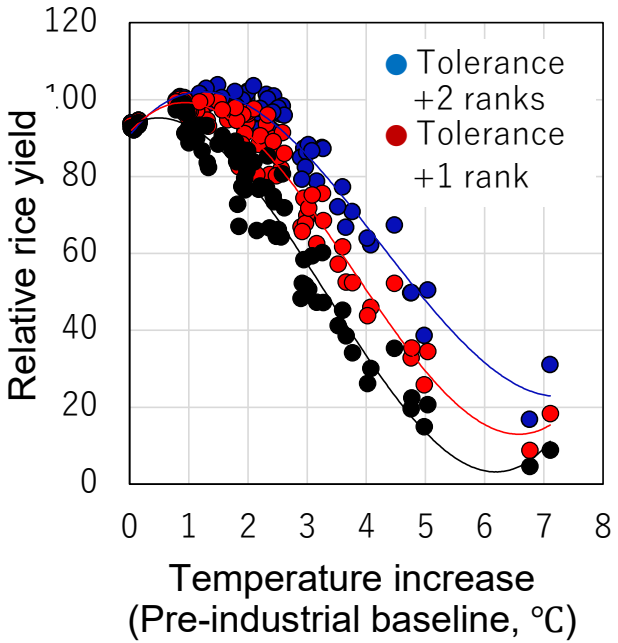


Fig. 1 Unpolished rice damaged by warm temperatures
(Source: "The story of rice development" Sai-no-kizuna website)



(3) Nature-based Solution (NbS)
Ecosystem-based Adaptation（EbA）

Disaster Prevention, Infrastructure, Urban Planning

Green Infrastructure

- Utilizing the diverse functions of the natural environment
- Aiming to create sustainable and attractive communities.

EcoDRR (Ecosystem-based Disaster Risk Reduction)

- The use of ecosystem functions to prevent and mitigate disasters.

EbA (Ecosystem-based Adaptation)

- Adaptation measures to climate change that leverage the functions of ecosystems.

NbS (Nature-based Solutions)

- Actions that address societal challenges by managing the natural environment.
- Simultaneously delivering co-benefits for humans and biodiversity.

(4) Adaptation for City Innovation

Copenhagen's Challenges

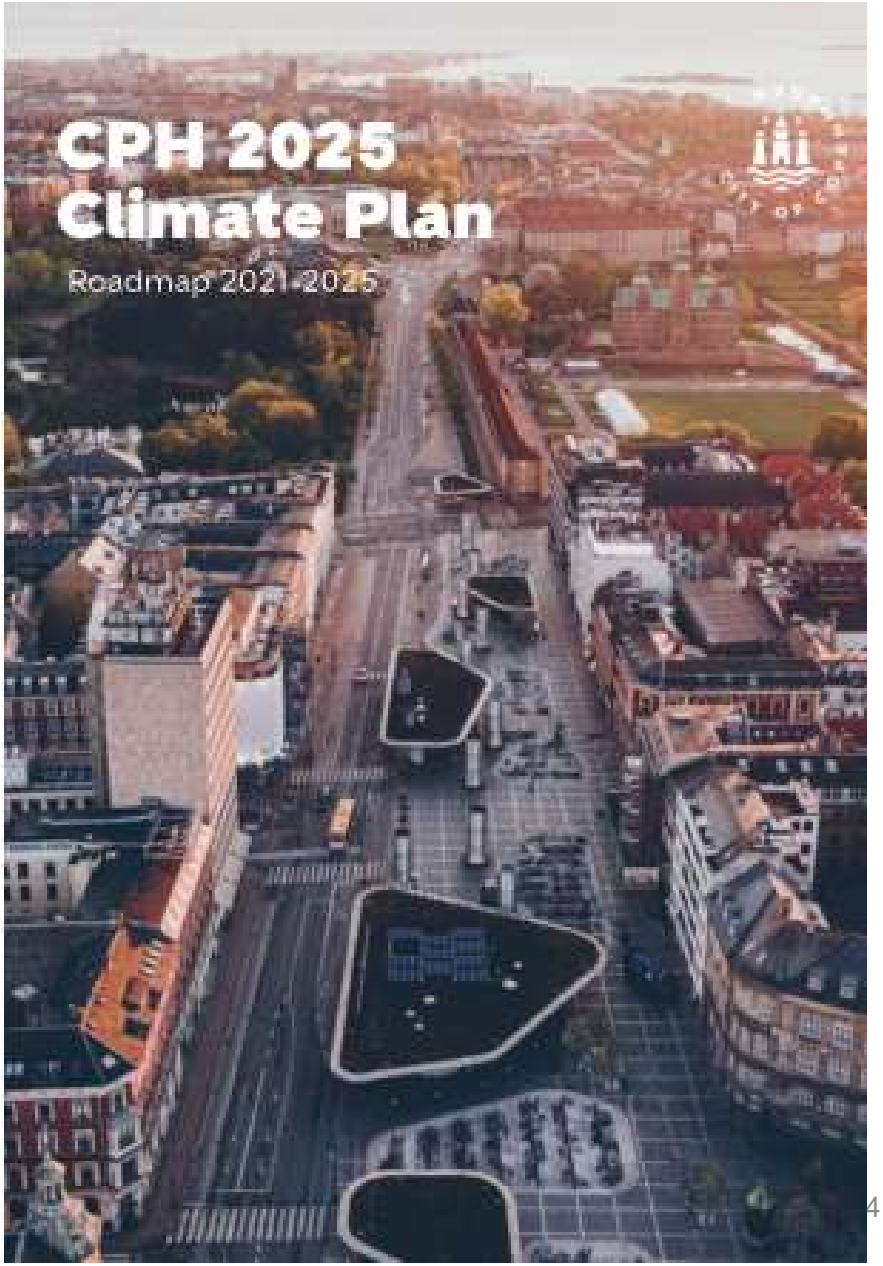
2011 Copenhagen Climate Adaptation Plan

2012 CPH 2025 Climate Plan

2016 First Climate Resilient Neighborhood

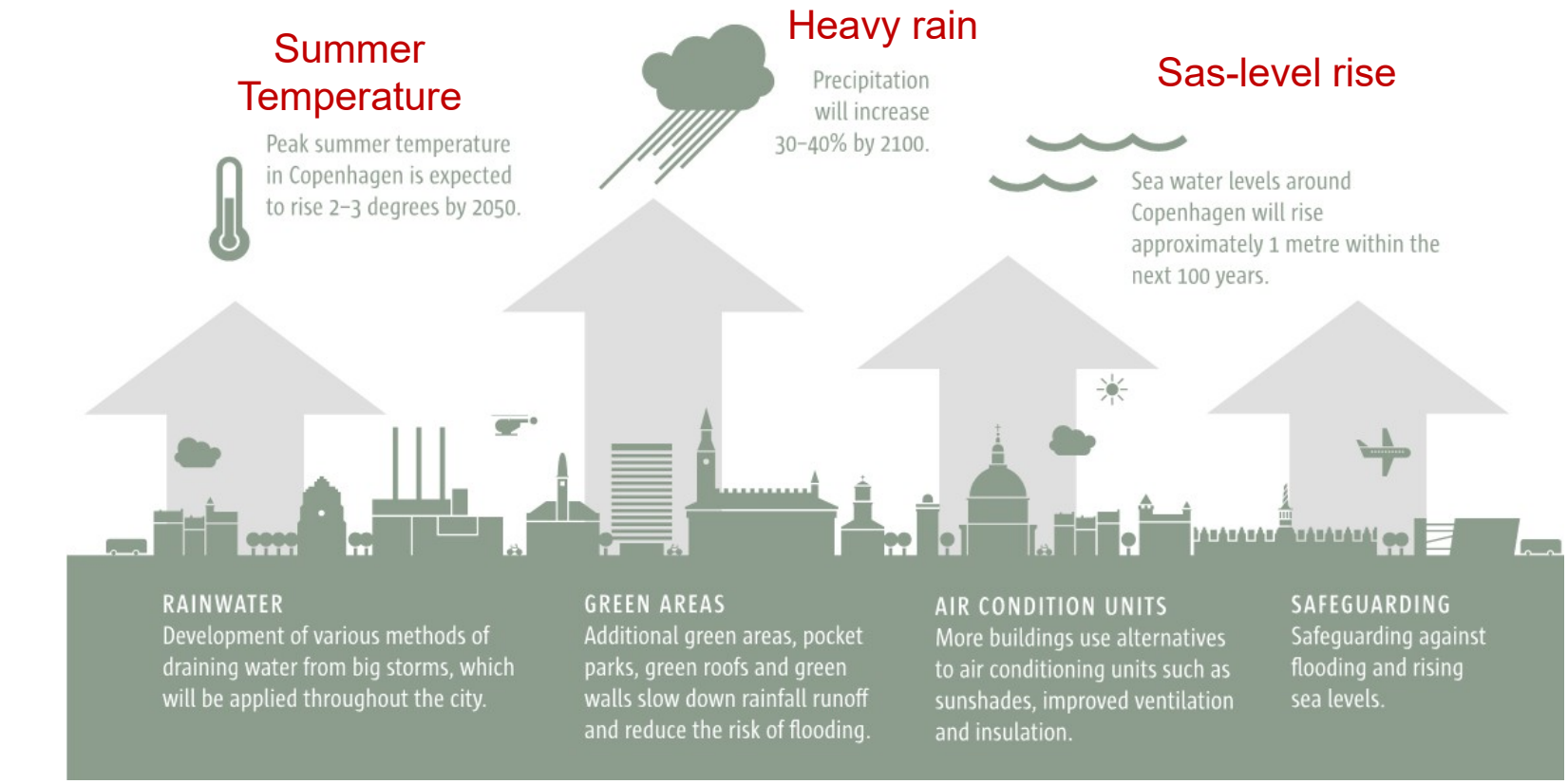
2021 CPH 2025 Climate Plan
- Roadmap 2021–2025
（5-year Action Plan）

【Targets】
- **World first carbon neutral capital by 2025**
- **Excellent chance for urban development**



【Adaptation Plan】

- **Climate change planning is an excellent chance for urban development**

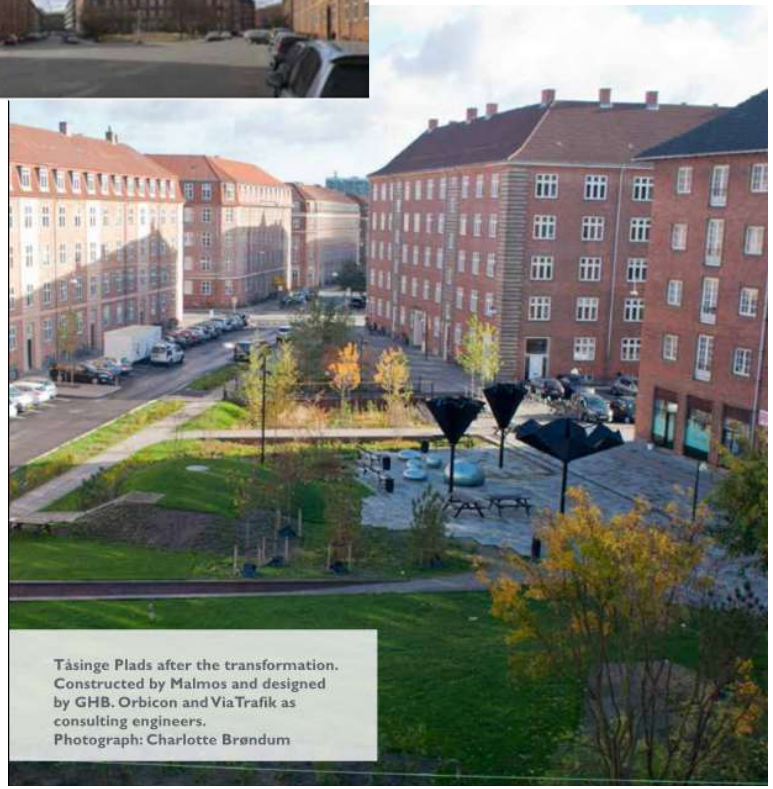


Urban Flood Management	Greening	Heat Measures	Flood Prevention

Copenhagen Solution for Sustainable Cities

Urban Greening: From City-level to Neighborhood

- To make the city more attractive, heat-torelant and resilient



Tåsinge Plads after the transformation. Constructed by Malmos and designed by GHB. Orbicon and ViaTrafik as consulting engineers. Photograph: Charlotte Brøndum

PROJECTS

1 TÅSINGE PLADS

The Climate Resilient Neighbourhood's first urban space adapted to climate change. Here rainwater from an area of more than 7,000 m^2 is managed, while a multifunctional green urban space is created for the neighbourhood.

2 SKT. KJELDS PLADS

A green square full of character, the future gathering point of the neighbourhood, and at the same time a pilot project in climate change adaptation. The project is expected to be completed in 2018.

3 BRYGGERVANGEN

A green connecting link, where raingardens, swales etc. provide experience of nature in the centre of the city. The project is expected to be completed in 2018.

4 KILDEVÆLDSPARKEN

Frisporet is a new activity space north of Kildevældsparken. The focus is on nature, play and discovery. In addition, there is a park for dogs and new playing fields.

5 HARALDS PLADS

Haralds Plads was renovated in the autumn of 2015. A large green bed with perenials and schrubs has been created and benches have been installed, including urban furniture for skating.

6 STRANDBOULEVARDEN

Strandboulevarden will in the future become a blue and green street that both protects the area against flooding and creates a liveful and green space.

28

7 ØSTERBROGADE / CARL N. ALLÉ

The streets ensure that the rainwater is transported to the harbour and at the same time green spaces is developed.

2 FUTURE GREEN COURTYARD AT SKT. KJELDS PLADS

A pilot project on rainwater management in courtyard spaces.
Expected to be completed in 2016.

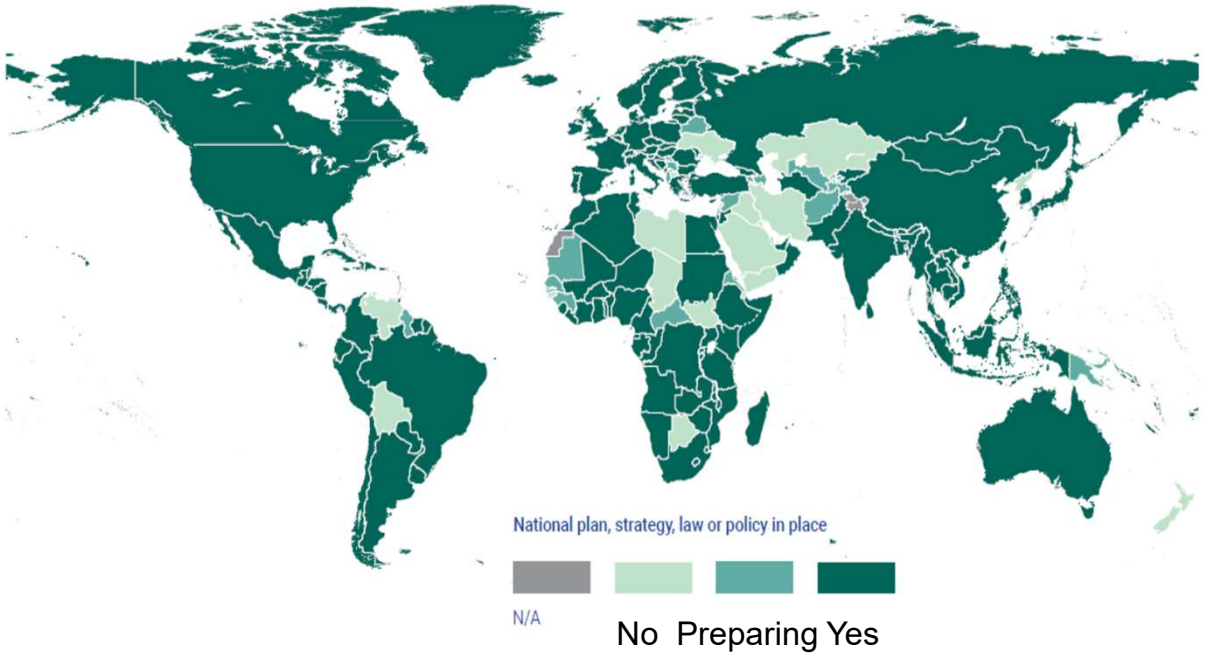
4 CLIMATE RESILIENT BLOCK

A sustainable project where rainwater management, and rainwater collection and energy optimisation of buildings.

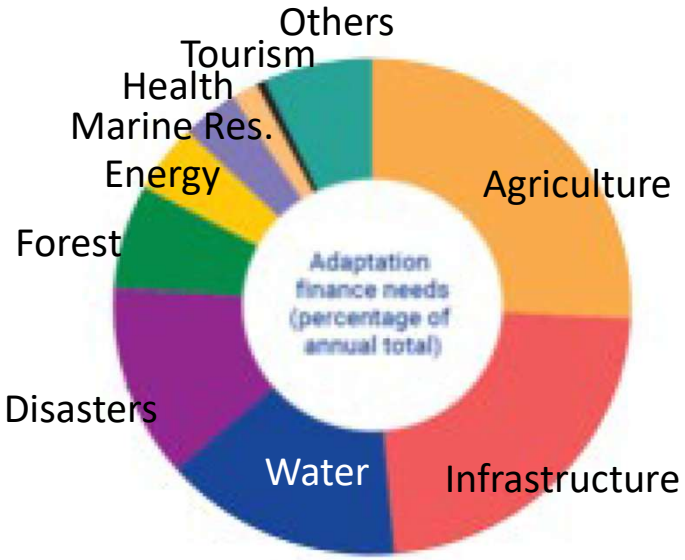
Copenhagen's first-climate resilient neighborhood, 2016

Global Landscape of CC Adaptation

- Adaptation Planning: 80% of countries have adaptation plands or initiative
- Major targets are Agriculture, Infrastructure, Water and natural disasters.



Adaptation Planning

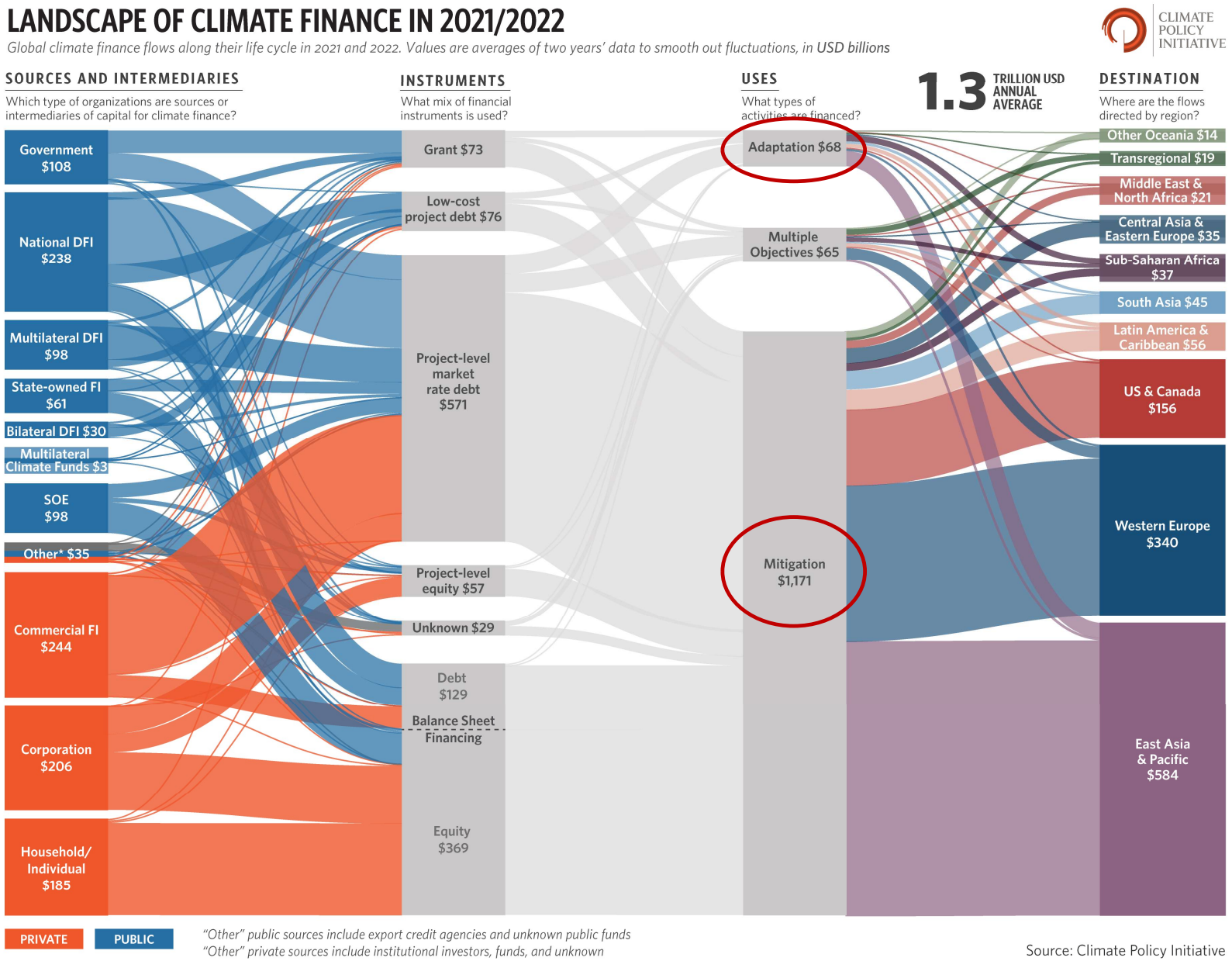


Sectoral Funding Needs
(26 Countries)

(Source: UNEP Adaptation Gap Report, 2021)

Financial Flows

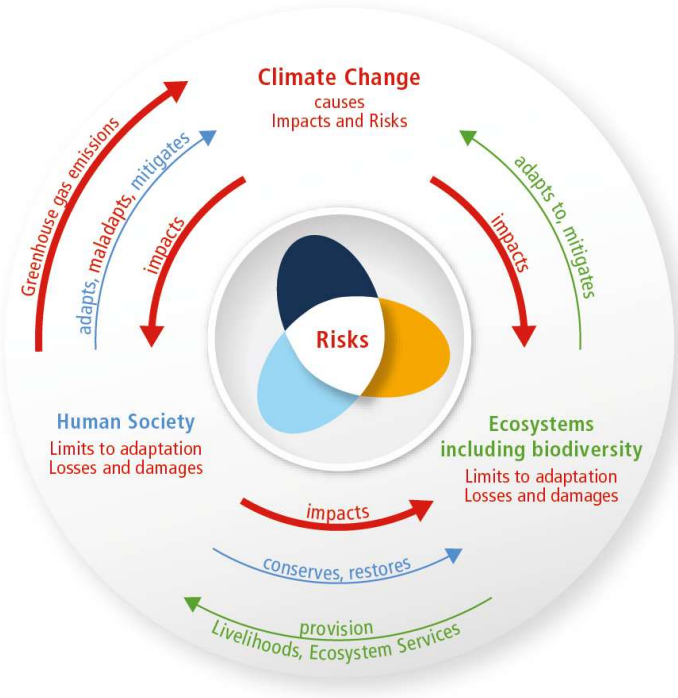
- Adaptation 68 B$
  Mitigation 1,171B$
- No substantial flows to the Global South
- Given the severe impacts, adaptation is critical for the Global South.
- Adaptation has synergies with the development targets.



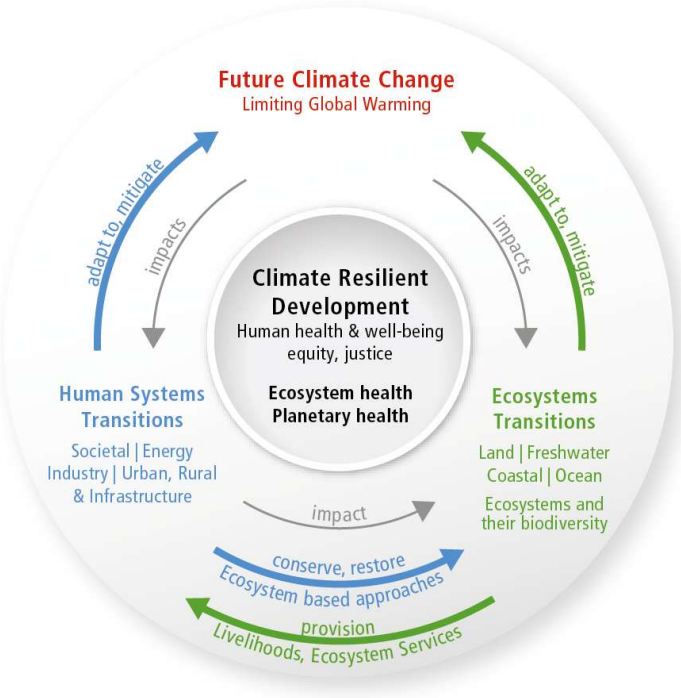
Climate Resilient Development (CRD)

- Reduce climate risks – adaptation
- Reduce greenhouse gas emissions – mitigation
- Enhance biodiversity
- Achieve the Sustainable Development Goals

(a) Main interactions and trends



(b) Options to reduce climate risks and establish resilience



IPCC WG II(2022)

Summary: Role of Adaptation

Risk Management of Climate Change

- Adaptation is to minimize impacts and damages caused by CC.
- Integration of mitigation and adaptation
- Need to note “the limit to adaptation”

Drivers for a Resilient and Sustainable Development

- Wider implications of CC responses
- Solutions with multiple effects: NbS, City innovation, Regional revitalization
- Contribute to transition to Resilient and Sustainable Development

  Mitigation: **Zero-emission society** based on renewable energies.

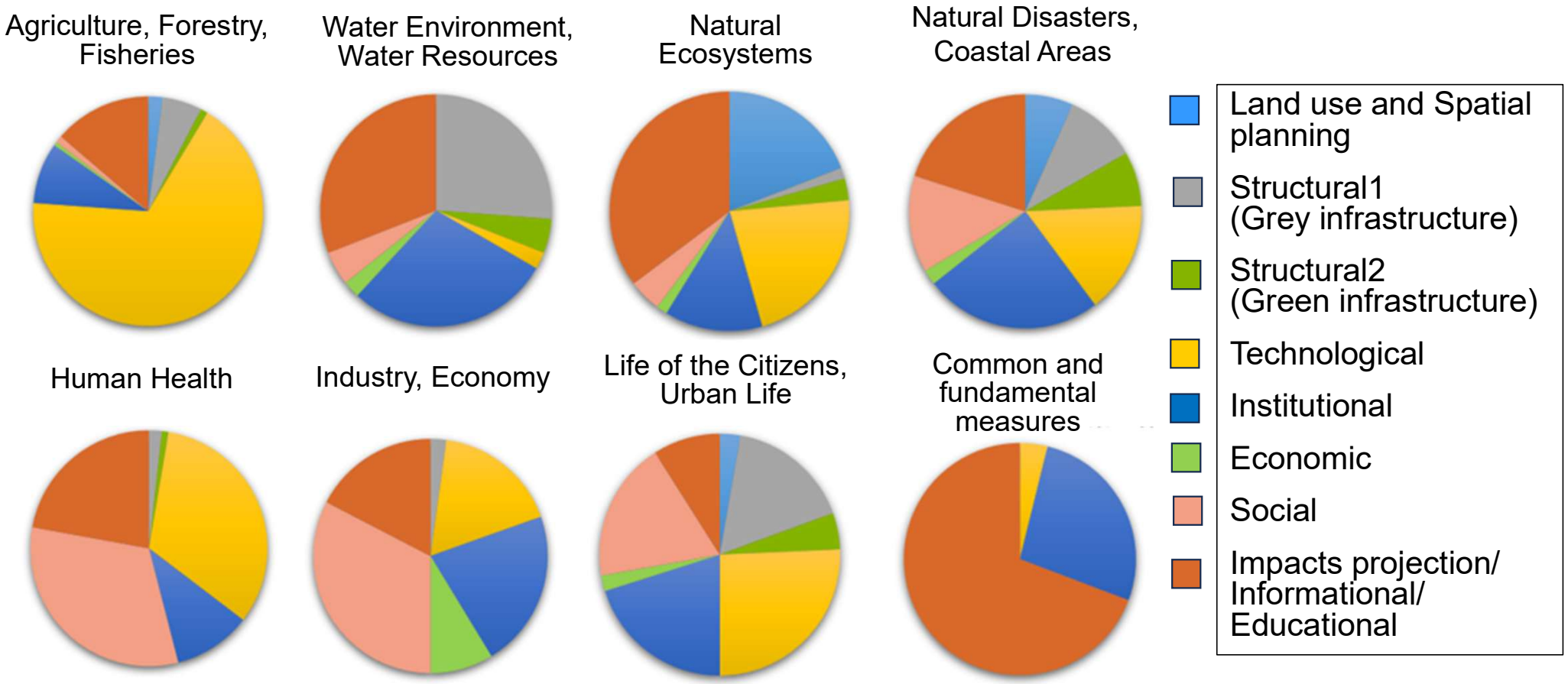
  Adaptation: **Climate resilient society**

CC Adaptation plays a role to overcome the current gap of “ideals and realities”.

Thank you for your attention!

Appendix 1

Distribution of Adaptation Option Categories by Sector in Japan

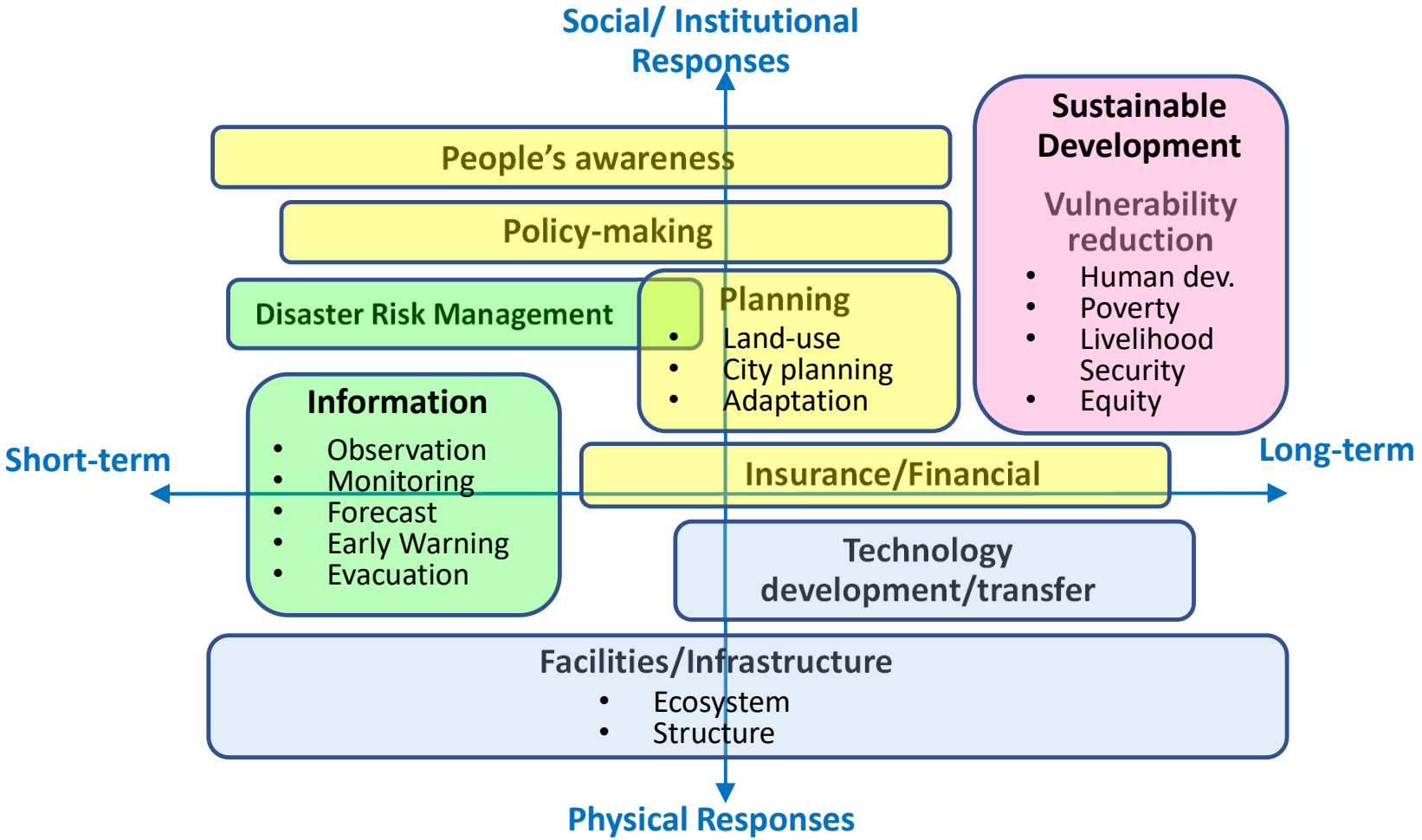


- Adaptation measures depend on the impacts, regional environments, and social characteristics.

Appendix 2

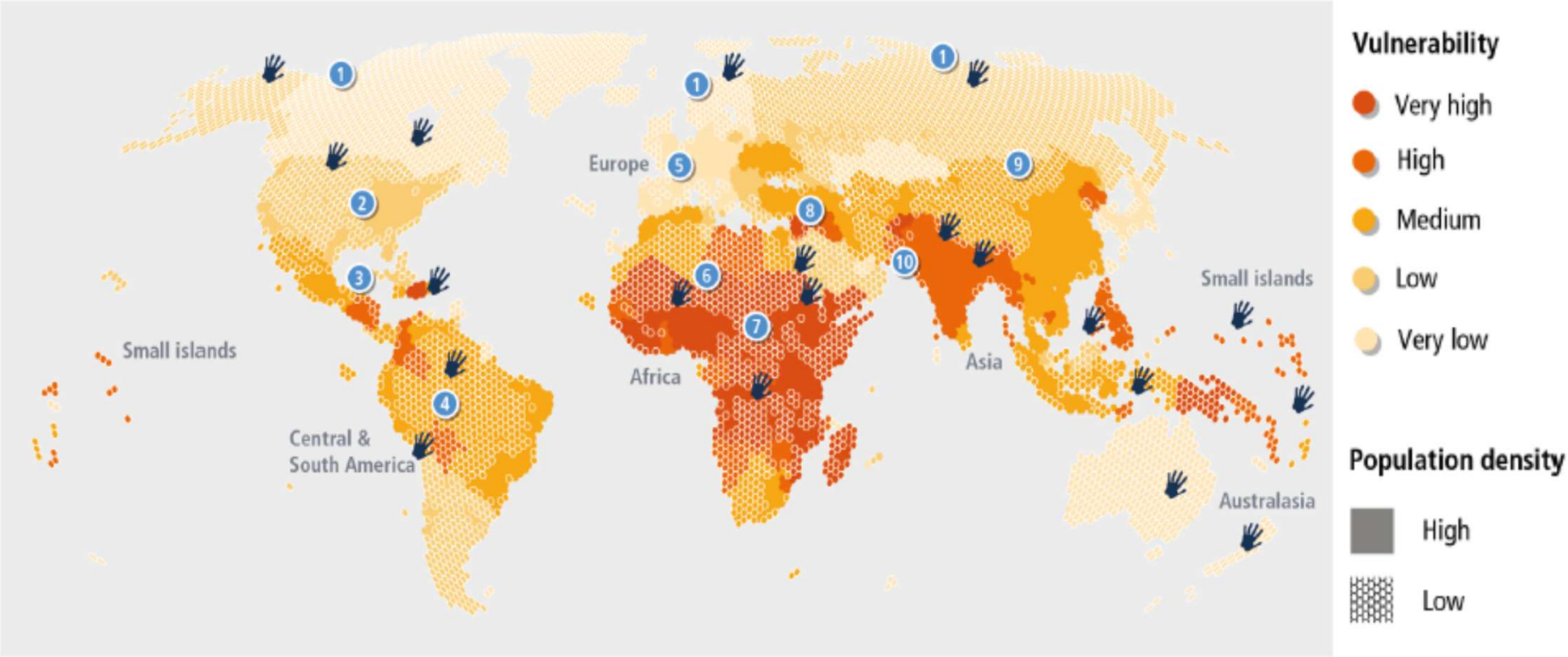
Elements of Society's Resilience (Adaptive Capacity)

- Building the society's resilience means developing the comprehensive capacity of the society to respond to threats caused by CC and other hazards.



Appendix 3

Distribution of Vulnerability in the World



- Vulnerable regions include Africa, South Asia, Latin America, small island nations, and the Arctic. Currently, 3.3 billion people live in these areas.
- Even in developed countries, vulnerable populations such as the poor, children, the elderly, and people with disabilities are more severely affected.

（IPCCAR6 WG2 Report SPM ,2022）