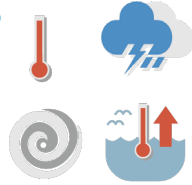


Buildings and Facilities

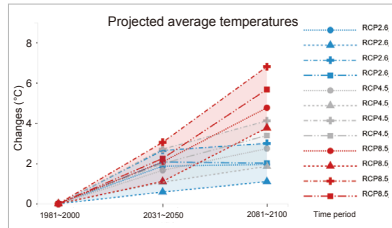
Major Factors of Impacts

Rising temperatures, increased frequency and intensity of extreme weather events, increased number of large typhoons, and rising sea levels



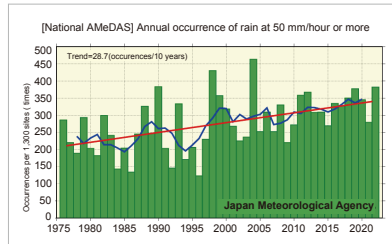
Current Situation and Future Projections

Average temperatures in Japan are increasing at a rate of 1.24°C /100 years. Heavy rainfall is also on the increase and precipitation patterns are changing, indicating that heavy rains and large typhoons are expected to increase further. Sea water temperatures are also expected to rise.



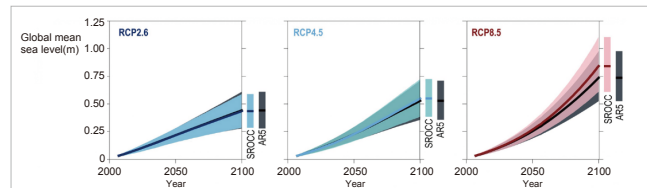
Projected average temperatures (annual average temperature projections based on emission scenarios and climate models (difference from standard period)) Source: A-PLAT

The sea level around Japan has been rising since 1980. Worldwide, the sea level is likely to rise by 0.29-1.10 m at the end of the 21st century compared to 1986-2005. There are studies that predict changes in typhoon characteristics, an increase in storm surge anomalies, and an increase in storm surges on the Pacific side of Japan.



Changes in the annual occurrence of precipitation of 50 mm/hour or more in Japan Source: Japan Meteorological Agency website (translated by NIES)

Projected global mean sea level under RCPs 2.6, 4.5, and 8.5 (in meters)



Source: IPCC(2019)

Adaptation

To address disaster risks, optimal combination of soft measures such as BCP and hard measures such as improvement of disaster prevention functions should be strategically and adaptively implemented. To respond to anticipated performance deterioration and changes in maintenance costs, effects of climate change should be accurately assessed through regular inspections of buildings and facilities, and countermeasures such as reinforcement and improvement of facility functions should be taken.

Factors

Rising temperatures/increased heavy rainfall, large typhoons/rising sea levels and storm surges

Impacts

Increased disaster risk

- Increased risk of damage from wind, flood, storm surge, etc.
- Increased costs for restoration of damaged buildings and facilities



Degraded performance/Increased maintenance risk

- Degraded facility performance and functionality
- Increased costs for cooling
- Increased power system load in summer and winter
- Shortage for electricity facilities and power systems



Adaptation measures

Soft measures Disaster response measures

- Precautionary measures** Formulate and implement BCP

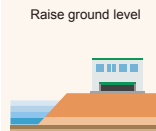
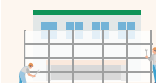


- Remedial measures** Continue business at alternative locations

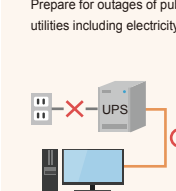


Hard measures Improve disaster prevention functions

- Buildings** Repair and reconstruct Construct external levee



- Facilities & Equipment** Prepare for outages of public utilities including electricity Install water barrier panels and watertight doors



Soft measures Facility inspection

- Revise design standards for facilities**



- Monitor**

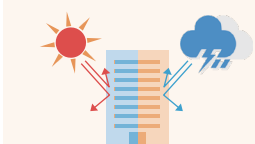


Hard measures Install equipment/improve functions

- Install highly efficient air conditioning**



- Improve insulation of facilities**



- Reinforce and implement measures based on regular inspections**





Buildings and Facilities

Climate change impacts and adaptation measures on "buildings and facilities" common to various industries

Back

Factors

Rising temperatures/increased heavy rainfall, large typhoons / rising sea levels and storm surges

Impacts

Increased disaster risk

- Increased risk of damage from wind, flood, storm surge, etc.
- Increased costs for restoration of damaged buildings and facilities
- Increased costs for disaster prevention and mitigation construction

Degraded performance / Increased maintenance risk

- Degraded facility performance and functionality (due to changes in temperature, precipitation (including snowfall), wind, etc.)
- Increased costs for cooling due to rising temperatures, decreased costs for heating
- Increased power system load in summer and winter
- Effects of extreme temperature changes on operation of each facility
- Increased costs for maintenance and renewal works

Adaptation measures

Soft

[Disaster response measures]

Precautionary measures

- Formulate and operate BCP (reinforce disaster response, disaster drills)
- Revise building design conditions and standards
- Acquire weather information at an early stage and formulate disaster prevention plans
- Conduct regular inspections of buildings and facilities
- Take out damage insurance
- Move or relocate critical equipment and storage to locations with low risk of flooding

Remedial measures

- Continue business at alternative locations (Alternative locations should be selected in advance)

Hard

[Improve disaster prevention functions]

Buildings

- 1) Repair (reinforce and implement measures in accordance with regular inspections of the structure)
- 2) Reconstruct (repair and reconstruct facilities, install green infrastructure)
- 3) Raise ground level
- 4) Construct external levee
- 5) Optimal placement of facilities

Facilities & Equipment

- 6) Prepare for outages of public utilities including electricity (e.g., securing multiple means of energy such as radio and satellite phone communication networks, uninterruptible power supplies (UPS), power generation equipment and air conditioning for power outages, etc.)
- 7) Locate critical facilities (power receiving and transforming equipment, emergency generators, etc.) on upper floors
- 8) Install water barrier panels and watertight doors
- 9) Introduce high-performance insulation, solar shielding, and highly efficient air conditioning

Soft

[Facility Inspection]

- 1) Revise design standards for facilities
- 2) Monitor (constant monitoring of equipment performance, energy usage, etc.)
- 3) Early detection of performance degradation through regular inspections
- 4) Promote manpower-saving and automated inspections using ICT, AI, and other technologies

Hard

[Install equipment / Improve functions]

- 1) Install highly efficient air conditioning
- 2) Install power generation and air conditioning systems that reduce load on power system
- 3) Improve insulation of facilities
- 4) Introduce buildings with high environmental performance including ZEB
- 5) Reinforce and implement measures based on regular inspections
- 6) Introduce climate resilient buildings and green infrastructure
- 7) Deploy robots for regular building inspections
- 8) Install disaster detection and forecasting systems

Effect

Low

1) 8)Medium 2) ~ 5)High 6) 7) 9)Low

1) ~ 2)Low 3) ~ 4)Medium

Medium ~ High

Cost

Low

1) ~ 5)High 6) Low ~ Medium 7) 9)Low 8)Medium

Low ~ Medium

Medium ~ High

Time span

Short

1) ~ 4)Medium 5)Long 6) ~ 8)Short 9)Short

1) ~ 3)Short 4)Medium

1) ~ 3),5)Short 4),6) ~ 8)Medium ~ Long

How to proceed with adaptation measures

[Climate change-aware approach] It is necessary to take measures to respond to effects such as impacts of rising temperatures on facilities and damage to facilities caused by heavy rainfall.

[Preparing and planning for climate change] For disaster risks, it is necessary to strategically and adaptively promote the optimal combination of soft measures, such as BCP; and hard measures, such as improving disaster prevention functions. For expected performance deterioration and changes in maintenance and management costs, it is necessary to accurately identify the effects of climate change through regular inspections of buildings and facilities, and to take measures such as reinforcement and equipment upgrades.

[References] Ministry of the Environment (2022) "Climate Change Adaptation Guide for Private Sector - Preparing for Climate Risk and Surviving" https://adaptation-platform.nies.go.jp/private_sector/guide/index.html, Japan Meteorological Agency "[National AMeDAS] Annual occurrence of rain at 50 mm/hour or more" https://www.data.jma.go.jp/cpdinfo/extreme/extreme_p.html, Japan Meteorological Agency (2020) "Climate Change Monitoring Report 2019" https://www.data.jma.go.jp/cpdinfo/monitor/2019/pdf/ccmr2019_all.pdf, Ministry of Land, Infrastructure, Transport and Tourism (2017) "Case Studies of Efforts to Prevent Flood Damage - Towards Minimizing Socio-Economic Damage" https://www.mlit.go.jp/river/bousai/shinsuihigai/pdf/171225_zentai_lo.pdf, National Institute for Environmental Studies, Climate Change Adaptation Information Platform (A-PLAT) "Climate Change Observation and Projection Data" <https://adaptation-platform.nies.go.jp/map/index.html>, AEA group (2010) "Adapting the ICT Sector to the Impacts of Climate Change - Final Report" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/183486/infrastructure-aea-full.pdf, Fu, G., Horrocks, L., & Winne, S. (2016) "Exploring impacts of climate change on UK's ICT infrastructure" Infrastructure Asset Management, 3(1), 42-52. https://eprints.ncl.ac.uk/file_store/production/213790/228F678D-C7F8-4B18-850F-19A838600D73.pdf, IPCC(2019) "Special Report on the Ocean and Cryosphere in a Changing Climate (Chapter 4: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities)" <https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/>