

## 5.14. Industrial Area

### 5.14.1. Climate Risks in Industrial Area Sector<sup>48</sup>

The major flood that occurred in the Chao Praya River in Thailand in 2011 flooded seven major industrial areas (industrial zones), where many manufacturing facilities of Japanese companies were located, resulting in more than 800 deaths and more than \$40 billion in economic damage. In particular, these industrial parks played a part in the world's supply chain, and the central of the supply chain due to inundation had a major impact on the world economy, especially in the manufacturing industries such as hard disk drives, cameras, and automobiles. Private businesses have been taking measures to avoid and mitigate the impact of natural disasters on foreign business activities, but it is projected that large-scale disaster risks due to climate change will increase in the future. For this reason, it is necessary to accurately evaluate the impact of interruptions in the global supply chain caused by disasters, etc. and to take appropriate measures.<sup>49</sup>

Climate change impacts on industrial parks have direct impacts and indirect impacts on other systems outside the industrial park, as follows. It is necessary to consider not only the impacts that occur only in industrial parks, but also the effects of related infrastructure and services outside industrial parks, such as logistics and energy supply. In addition, the vulnerabilities of the industry sectors themselves to which businesses operating in industrial parks belong may have an impact.

**Table 89 Direct and Indirect Impacts of Climate Change on Industrial Areas**

Direct and indirect	Examples of the impacts
Direct influence	<ul style="list-style-type: none"> <li>• <u>Facilities and infrastructure within industrial parks are affected by floods and storms (e.g., damage to infrastructure such as private roads, buildings, water, and electricity).</u></li> <li>• Working environment of employees is affected by the rise in average temperature</li> </ul>
Indirect impacts	<ul style="list-style-type: none"> <li>• Energy suppliers and suppliers of materials to industrial parks are affected (e.g., abnormally high temperatures and flooding cause the system of electricity suppliers outside the industrial park to stop, reducing production within the industrial park).</li> </ul>

#### Potentially affected by hazards

For example, the following may be influenced by hazards in and out of industrial areas.

- Sites for industrial areas (location, site planning, etc.)
- Infrastructure services related to industrial areas (water supply, power supply, wastewater treatment, waste management, etc.) Business operators operating in industrial areas (production, etc. of products of business operators located on the premises)
- Products produced in industrial areas (such as products stored on the premises)
- Distribution (distribution of products produced in industrial areas, etc.)
- Employees working in industrial areas

<sup>48</sup> Following the revision of the Rio Marker Indicative Tables on January 20, 2025, new guidance has been added stipulating that industrial activities with high GHG emissions should not be assigned an adaptation marker—even if adaptation measures are implemented—unless they are also accompanied by mitigation measures. Nevertheless, even when a project involving high-GHG industrial activities does not include mitigation measures, it remains significant to consider the adaptation measures required to ensure the project achieves its intended outcomes. Accordingly, the use of Climate-FIT (Adaptation) for evaluating climate risks and examining adaptation measures is not precluded, even for projects involving high-GHG emitting industrial activities that lack mitigation measures.

<sup>49</sup> "Policy on Scientific Knowledge and Climate Risk Information for the Promotion of Climate Change Adaptation Measures (Interim Report)," March 2017, Subcommittee on Climate Change Impact Assessment, Global Environment Subcommittee of the Central Environment Council

The following tables provide examples of parameters for each category, as a reference for climate risk assessments for JICA projects in each sector. Note that it is not necessary to cover all items listed here, and this is not an exhaustive list. Based on the characteristics of each project, it is assumed to be used as a reference from the viewpoint of consideration when appropriate.

**5.14.2. List of Climate Risk Components for Industrial Area Sector**

**Table 90 Example of climate hazards for a project in the Industrial Area Sector**

Climate hazard category	Examples of items for review based current and projected values
Changes in temperature	Temperature variations (annual, monthly, daily)
Heat waves, cold waves	Annual average temperature
	Monthly average temperature
	Timing/duration of heat wave/cold waves (timing, duration, scale)
Changes in precipitation	Annual precipitation
	Monthly precipitation
Fog	Frequency of fog occurrence (timing, duration)
Heavy rainfall	Frequency of heavy rainfall events
Storms (typhoons)	Frequency of occurrence, intensity (wind speed)
Wind speed	Change of wind speed
Wind direction	Prevailing wind
	Change in wind direction characteristics
Flood, inundation	Annual precipitation
	Monthly precipitation
	Daily precipitation
	Hourly precipitation
	Occurrence patterns of floods and inundation (statistical data on timing, duration, scale)
Drought, water scarcity	Number of consecutive dry days
	Monthly precipitation changes
	Occurrence patterns of droughts and water scarcity (statistical data on timing, duration, scale)
Storm surges, high waves	Occurrence patterns of storm surges and high waves (timing, scale)
	Sea-level rise

**Table 91 Example of exposure for a project in the Industrial Area Sector**

Exposure category	Examples of items to review and identify
Hard infrastructure	Industrial park infrastructure, related facilities, etc.
	Size of each structure/facility (numbers, specs) Asset value of each facility (assessed value)
Soft infrastructure	Project-related organization and personnel Size of organization (personnel numbers, structure), roles, etc.
Surrounding environment	Companies and other entities located in the industrial park Tenant businesses in the industrial park
	Workforce at the industrial park Numbers of workers at the industrial park

**Table 92 Example of vulnerability for a project in the Industrial Area Sector**

Vulnerability category	Examples of items to identify and examine
Hard infrastructure	Industrial park infrastructure, related facilities, etc.
	Location (distance from coastline, river, etc.), ground elevation
	Resilience to climate hazards for each type of facility/equipment
	Status/development of drainage systems
	Status of installation of disaster prevention equipment, such as flood barriers, fire-prevention facilities, and other disaster prevention equipment

Soft infrastructure	Project-related organization and personnel	Existence of industrial sector zoning plans in based on environmental conditions
		Degree of planned rainwater drainage system setup and maintenance implementation
		Design and construction of buildings with appropriate lightning strike countermeasures
		Level of understanding of climate change, etc.
		Status of Business Continuity Plan (BCP) formulation for climate change and extreme weather
		Response system (including personnel) in the event of extreme weather events, etc.
Surrounding environment	Companies and other entities located in the industrial park	Level of understanding regarding climate change, etc.
		Status of Business Continuity Plan (BCP) formulation for climate change and extreme weather
		Response systems (including personnel) in the event of extreme weather, etc.
		Financial capacity to implement countermeasures against climate change and extreme weather, etc.

**Table 93 Example of climate risk for a project in the Industrial Area Sector**

Climate risk category		Examples of climate risks
Hard infrastructure	Infrastructure and related equipment in the industrial park	Damage or damage to roads and storage facilities due to floods, high temperatures, etc.
		Inundation of building structures
		Overload of the wastewater treatment system, exceeding the allowable amount
		Deterioration of coastal erosion in port and harbor facilities (such as quays, breakwaters, quays, and tidal levees)
		Impassability of wharves and connecting roads from wharves
		Short-circuiting of the underlying electrical equipment
		Clogging of drainage outlets due to storms
		Inundation and flotation of equipment and tanks
		Diffusion of contaminated soil and substances due to floods, etc.
		Damage to port and harbor infrastructure due to increased rapid movement of seawater and river tides
		Increase in corrosion rates due to flooding, flooding, and elevated temperatures
		Heat stress and changes in radiation stress due to rising temperatures
Soft infrastructure	Project-related organization and personnel	Increased frequency and intensity of facility and equipment repairs and maintenance (increased costs)
		Increased maintenance costs
		Increased insurance costs
Surrounding environment	Tenant businesses	Damage to companies located in the industrial park
		Adverse human impacts on the industrial park grounds
		Suspension of production functions in factories due to flooding and heavy rain inundation, and the overflow of waste materials associated with inundation, etc.
		Restrictions and delays in access to various markets and sales channels from the industrial park
		Shortage and interruption of raw material supply
		Increased costs due to the need for more repair/refurbishment of facilities/equipment, maintenance frequency, reinforcement
	Workforce at the industrial park	Increased occurrence of natural disasters, etc.
		Occurrence of human casualties
	Others	Existing coastal flood protection standards provided by breakwaters, revetment works, etc., become insufficient due to sea-level rise and storm surges

		Reduced investment returns from financial institutions due to the presence or absence of incorporating climate change impacts into the decision-making process
		Global supply chain disruptions, such as the suspension of manufacturing and supply of key components delivered to global manufacturers
		Decrease in usable water volume for industrial use (including groundwater and surface water)
		Increased financial losses due to the suspension of business activities such as factory operations and transportation stoppages due to flooding, etc.
		Reduced productivity and revenue due to loss or disruption of ICT
		Increased exposure opportunities for mortgage lenders (increased collateral opportunities such as transferred mortgage debt)
		Increased opportunities and amounts for the insurance industry due to flooding
		Decrease in domestic firms' production due to increased turmoil in the supply chain due to extreme weather
		Prevalence of new diseases within workers with changes in disease patterns due to climate change
		Increased conflict with vulnerable communities in the vicinity where livelihoods are adversely affected by climate change (e.g., artificial fisheries)
		Negative impact on the overall economic activity of the industrial park due to changes in the national socio-economic situation affected by climate change (e.g., increased national poverty and anxiety caused by the loss of land and water stress, etc.)

**Table 94 Example of adaptation measures for a project in the Industrial Area Sector**

Adaptation measure category		Examples of adaptation measures
Hard infrastructure	Infrastructure development	Construction, introduction, and replacement of buildings/machinery resilient to climate change impacts (e.g., waterproofed, with flood control measures)
		Establishment of setback zones or relocation of buildings located in potentially affected areas
		Introduction and reinforcement of equipment to protect critical/expensive machinery and underground facilities (e.g., underground water pumping stations, sealed sewer systems) from flood damage
		Introduction and construction of heat-resistant roofs (such as a 30-degree roof gradient and the use of heat-resistant materials) in storage facilities and buildings in the industrial park against storms and high-temperature damage
		Introduction and installation of movable barriers (as countermeasures against floods and strong winds)
		Reducing exposure and reconstruction through the relocation (or movement to higher elevations) of critical infrastructure
		Regularly maintaining roads to prevent subsurface erosion
		Enhancing building shading, ventilation, and cooling functions to lower indoor temperatures; introducing cooling processes/machinery within the production processes of ICT facilities, factories, etc.
		Introduction of renewable energy supplies from the industrial park and neighboring areas to ensure sustainable electricity backup in the region and to prevent negative impacts on the grid and other power generation facilities
		Expanding storage capacity for critical supplies (to minimize the impact of delivery and manufacturing delays)

Soft infrastructure	Water-use	Introducing and developing appropriate drainage treatment systems with flood control measures (e.g., separation of stormwater and sewage systems)
		Enhancing water efficiency in production processes, strengthening water storage facilities within the industrial park, and introducing water reuse technologies (introduction of low-water irrigation technologies such as drip irrigation, rainwater utilization, and greywater reuse)
	Land development	Regularly performing maintenance and cleaning of drainage channels to ensure drainage function
		Expanding green spaces and water features within the industrial park to mitigate the heat island effect
	Disaster Prevention Measures	Implementing countermeasures to prevent the leakage of chemical substances and pollutants even during flooding
		Implementing measures to improve, strengthen, and increase the securement of water sources used by each plant (introduction of water treatment and recycling systems, etc.)
		Improving the disaster prevention functions of hazardous material storage facilities
		Formulation and expansion of Business Continuity Plans (BCP) (reviewing anticipated damage due to climate change and adding scenarios of situations where the continuation of port and industrial park functions is difficult due to strong winds, waves, etc., even if not resulting in a disaster)
		Reviewing and formulating policies for cooperation systems with local governments during disasters (assignment of joint commanders, management of responsible organizations, etc.)
	Economic aspect	Aiming to increase credit line limits by implementing energy-saving measures
	Policies and regulations	Introducing the additional inclusion of evaluation content based on climate change impacts in mandatory environmental impact assessment processes
		Establishment of provisions on minimization of buffer zones/areas where residential construction is impossible in the vicinity of industrial zones
		Promoting public-private climate change risk reduction initiatives (coordination with local governments, etc.)
	Operation and design	Establishment of supervisory agencies and staff responsible for implementing measures to adapt to climate change impacts in the industrial park, formulation of overall management plans, and review of current standards and regulations
		Introducing the additional inclusion of evaluation content based on climate change impacts in mandatory environmental impact assessment processes
		Introducing early warning systems as disaster prevention measures against climate change impacts within the industrial park
		Formulation of land selection and development plans considering the impacts of climate change
		Developing and implementing rehabilitation plans for already affected locations/regions (providing incentives and relocation compensation for vulnerable industrial sectors)
		Reducing closed spaces and surfaces within the industrial park, establishing water storage locations on public land
		Optimizing building orientation (avoiding solar radiation on walls - mitigating the impact of east/west walls receiving the majority of low-angle sun exposure, etc.)
Implementing measures to prevent slope erosion during land planning (planting shrubs and trees, etc.)		

		Reviewing and formulating response plans leading up to shutdown plans (suspension of operations) in the event of emergencies
		Providing training to relevant planning agencies/departments on how to identify climate change risks and incorporate them into business (planning, decision-making, construction projects, etc.)
		Conducting vulnerability assessments of climate change-related risks at the business locations of major industrial companies during industrial park development
		Introduction of design and building standards with high vulnerability to climate change by the government, and determination of specifications for industrial buildings on site
		Avoiding structures susceptible to vibrations from strong winds, ensuring proper anchoring
		Integrating climate change aspects into the company's risk and innovation management processes (e.g., supply risks) and identifying critical components
		Investigating and considering the introduction of potential business opportunities arising from climate change within the industrial park (e.g., cooling technologies)
Surrounding environment	Companies and other entities located in the industrial park	Enhancing the diversity and efficiency of raw material procurement for production processes to avoid dependence on potentially climate change-vulnerable suppliers
		Securing suppliers in neighboring regions; similarly, ensuring diversity in sales channels for products within the industrial park
		Developing sustainable products within the industrial park that are less susceptible to climate change impacts
		Diversification of industrial sectors within the industrial park
		Sharing identified climate risk information with suppliers and discussing countermeasures
		Introducing climate insurance against climate change impacts, such as weather index insurance
	Promoting diverse industries, including small and medium-scale agriculture, to stabilize food supply within the industrial park	
	Workforce at the industrial park	Considering new work schedules to avoid heat stress for outdoor workers (provision of drinking water, shelters and disaster-prepared assembly points for workers, etc.)