



Climate Change Adaptation Policy for Industrial Areas

Framework for the State of Telangana, India

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Acronyms

CCA	Climate Change Adaptation
CEAC	Central Environmental Appraisal Committee
CETP	Common Effluent Treatment Plant
CFE	Consent for Establishment
CFO	Consent for Operation
CPCB	Central Pollution Control Board
CRA	Climate Risk Analysis
CSR	Corporate Social Responsibility
CZMA	Coastal Zone Management Authority
DPR	Detailed Project Report
DRM	Disaster Risk Management
DRR	Disaster Risk reduction
EIA	Environmental Impact Assessment
EIP	Eco-industrial Park
GoI	Government of India
GoTS	Government of Telangana State
IALA	Industrial Area Local Authority
IC	Industrial Corridor
IMD	India Meteorological Department
INDC	Intended Nationally Determined Contributions
IP	Industrial Park
MoEF&CC	Ministry of Environment, Forests and Climate Change
MSME	Micro, Small and Medium Enterprises
NAFCC	National Adaptation Fund on Climate Change

NAPCC	National Action Plan on Climate Change
NAPCC	National Action Plan for Climate Change
NDMA	National Disaster Management Authority
NEP	National environment Policy
NIDM	National Institute of Disaster Management
NIMZ	National Investment and Manufacturing Zones
NLP	National Land Use Planning
O&M	Operations and Maintenance
PF&IC	Price Fixation & Infrastructure Committee
SAPCC	State Action Plans for Climate Change
SAR	Site Analysis Report
SC/ ST	Scheduled Castes/ Schedule Tribes
SEA	Strategic Environmental Assessment
SEAC	State Level Environmental Appraisal Committee
SEZ	Special Economic Zone
SFC	State Financial Corporation
SLAC	State Level Allotment Committee
SMP	Site Master Plan
SOP	Standard Operational Procedures
SPCB	State Pollution Control Board
ST/SC	Scheduled Tribes / Scheduled Casts
TSIIC	Telangana State Industrial Infrastructure Corporation
ZM	Zonal Manager

Glossary

Adaptation	Any activity that reduces the negative impact of climate change, while taking advantage of new opportunities that may be presented as a result of climate change.
Cloud Burst	A cloudburst is an extreme amount of precipitation, sometimes accompanied by hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions. A cloudburst can suddenly dump large amounts of water e.g. 25 mm of precipitation corresponds to 25000 metric tons/km ² (1 inch corresponds to 72,300 short tons over one square mile). However, cloudbursts are infrequent as they occur only via orographic lift or occasionally when a warm air parcel mixes with cooler air, resulting in sudden condensation.
Conducted Strike	This occurs when lightning strikes a conductor and that in turn induces the current into an area some distance away from the ground strike point. Unprotected connected equipment can be damaged if they become an indirect path in the completion of the ground circuit.
Direct Strike	This is the most dangerous form, wherein the structure is a direct path for lightning currents to seek ground. The extent of the current determines its effects.
Down-slope wind	These are the winds blowing at / with very high speed down the slope of mountains
Drought	Droughts are periods of abnormally dry weather that results in serious hydrological imbalance. Droughts can be divided within the different hydrological cycle that they affect the most. Agricultural drought refers to abnormally low soil moisture, and hydrological drought implies a reduced runoff and groundwater recharge. The Indian Central Water Commission defined drought as “a situation occurring in an area when the annual rainfall is less than 75% of the normal (defined as 30 years average) in 20% of the years examined and where less than 30% of the cultivated area is irrigated”.
Flood	A flood is an overflow of water that submerges land which is usually dry. Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground.
Flood Plain	A lowland area, whether diked, flood proofed, or not, which, by reasons of land elevation, is susceptible to flooding from an adjoining watercourse, ocean, lake or other body of water and for administration purposes is taken to be that area submerged at the Designated Flood Level.
Heat Stress	Heat stress refers to the severe consequences of extreme heat for human health, affecting most strongly the vulnerable groups such as elderly, infants and children, as well as people with chronic heart or lung disease. Severe cases of heat stroke can cause death. It affects the labour

	productivity significantly in industrial parks.
Heat wave	Heat waves, also referred to as extreme heat events, are periods of abnormally hot weather, relative to the expected conditions of the area at that time of the year. IMD (India Meteorological Department) specifies heat waves by the maximum temperature of a station of at least 40°C for plains and at least 30°C for hilly regions.
Heavy Rainfall	Precipitation falling with an intensity in excess of > 7.6 mm (0.30 in) per hour, or between 10 mm (0.39 in) and 50 mm (2.0 in) per hour. Short periods of intense rainfall can cause flash flooding, longer periods of widespread heavy rain can cause rivers to overflow.
Lightening	Lightning is a sudden electrostatic discharge during an electrical storm between electrically charged regions of a cloud (called intra-cloud lightning or IC), between that cloud and another cloud (CC lightning), or between a cloud and the ground (CG lightning). The charged regions in the atmosphere temporarily equalize themselves through this discharge referred to as a strike if it hits an object on the ground, and a flash, if it occurs within a cloud. Lightning causes light in the form of plasma, and sound in the form of thunder. Lightning may be seen and not heard when it occurs at a distance too great for the sound to carry as far as the light from the strike or flash.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. Comment: Resilience means the ability to “recover from” or “spring back from” a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need. (UNISDR, 2015). According to the IPCC: “The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.” ((IPCC, Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Working Group II, 2014), p. 5)
Risk	The latest IPCC report now focuses more on risks whereas earlier reports applied the concept of vulnerability. The IPCC defines risk as ((IPCC, Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Working Group II, 2014), p.5): “The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. (...) the term risk is used primarily to refer to the risks of climate-change impacts.”
Sediment Control	Any temporary or permanent measures taken to reduce erosion, control siltation and sedimentation, and ensure that sediment-laden water does

	not leave a site.
Setback	Means withdrawal or siting of a building or landfill away from the natural boundary or other reference line to maintain a floodway and to allow for potential land erosion.
Sewer Backflow Flood Event	This type of flood event is noticeable in places where the sewer system is combined. When both storm-water and sewage flows through a single pipe, there would be situations of sewer system backflow, resulting in underground flooding.
Sheet erosion	This is the uniform removal of soil in thin layers from the land surface by winds. It occurs in areas where loose, shallow topsoil overlies compact soil.
Shortages in Energy Supply	Shortages in energy supply refers to the problems occurring in the electricity sector due to heat waves and droughts, which cause blackouts and brownouts.
Side Strike	This results from the disintegration of the direct strike when alternate parallel paths of current flow into the ground via structure. When the determined current path has some hindrance to current flow, a potential above ground develops and the structure's resistance to ground becomes the alternate path of conduction.
Splash erosion	This erosion occurs due to the impact of falling raindrop on the surface of soil.
Straight-line wind	High winds associated with intense low pressure can last for approximately a day at a given location. The blow in a straight line
Surface flood	Here the flood event is noticeable above ground and it occurs mainly due to overflow of water from any nearby river, lake or as a result of storm surge, heavy rainfall, or coastal inundation
Surge Protection Device	SPD also known as a transient voltage surge suppressor (TVSS), is designed to divert high-current surges to ground and bypass your equipment, thereby limiting the voltage that is impressed on the equipment.
Thunderstorm	They can form rapidly and produce high wind speeds. Thunderstorms often create heavy rain and they move very rapidly, causing high winds for few minutes at a location.
Water scarcity	Water scarcity is the lack of water due to low water availability and water demand exceeding the supply capacity – affected by the severity and frequency of droughts. Water scarcity has significant impacts on industrial parks in terms of production and processes.

Climate Change Adaptation Document Series

The Telangana State Industrial Infrastructure Corporation Ltd. (TSIIC), in cooperation and with support from GIZ, developed a set of documents targeting adaptation to climate change of existing and upcoming industrial areas in Telangana, India. The following table gives an overview of various documents developed and their scope.

Table 1: Policy documents for adaptation to climate change in industrial areas in Telangana State

	Document	Scope
1	Policy for Climate Change Adaptation in Industrial Areas	The policy is setting the frame for TSIIC's strategy to promote and implement adaptation of existing and upcoming industrial areas in AP to make the State industry and economy more climate resilient.
2	Guideline for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change	The guideline provides orientation and develops a standard approach and methodology on how to plan for adaptation and increasing resilience of existing and upcoming industrial areas in TSIIC.
3	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change, Part 1: Climate Risk Analysis	Part 1 of the manual includes the tools required to execute a climate risk analysis for existing and upcoming industrial areas. The results of the risk analysis provide a sound baseline to further plan and implement concrete adaptation measures, both in terms of infrastructure and operation, management and maintenance of the industrial parks in TSIIC.
4	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – Part 2: Engineering measures for planning adaptation and resilience measures	Part 2 of the manual includes the engineering required to translate the results of the risk analysis into concrete adaptation measures. According to the prevailing climate hazards in the state the tools focus on adaptation to heavy rainfalls and related impacts, and to heat waves and droughts and related impacts in TSIIC.
5	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – Part 3: Best practice examples	Part 3 of the manual presents a collection of national and international best practice examples and lessons learnt on adaptation of industrial areas, urban areas and infrastructures to the impacts of climate change. This also includes best practices on law and policies on climate change adaptation in TSIIC.
6	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – Part 4: Financing of plans and measures	Part 4 of the manual includes a collection of financing instruments and best practices for financing of adaptation measures in existing and upcoming industrial parks in TSIIC.
7	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – Part 5: Existing Planning and Implementation	Part 5 of the manual provides gives an overview on relevant actors and stakeholders and provides orientation on how the planning steps described in the guideline document are embedded in existing planning and working processes of in TSIIC.

	Procedure for Industrial Parks	
8	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – Part 6: Baseline studies in TS and AP	Part 6 of the manual presents the results of a pilot risk analysis and baseline study executed in selected industrial areas in TSIIC.
9	Training modules on execution of a climate risk analysis for existing and upcoming industrial parks and their adaptation to the impacts of climate change	To successfully implement the guidelines and even more important the respective adaptation measures in planning and refurbishment of industrial parks, APIIC has to develop the respective capacities in planning and operational departments. Furthermore, external capacities have to be supported and developed to be able to provide the required services to the infrastructure corporations and to individual industries and companies, particularly to (M)SMEs.

1. Preamble

1.1 Industry in Telangana State

Industrialization will be one of the key strategies followed for economic growth and development of Telangana, the newly formed 29th State of the country. People of the new State have very high expectations from the Telangana State Government for creating jobs for the youth, promote development of backward areas, maximize growth opportunities by optimum utilization of the available resources, harness the talents and skills of the people, and usher prosperity in every household. Industrialization holds the potential for fulfilling all the dreams and aspirations of the people of Telangana.

Telangana is one of the fastest growing state in with 9.2% in the year 2015-16, which is higher than national average of 7.5%. Industry contributes about 24% of total Gross Value Added (GVA) of the state, with total employment of 7, 07,738 (2012-13) (Socio-economic Outlook, GoTS, 2016), and fixed capital of Rs. 59,521 Crores for the year 2012-13.

The vision for industrialization of Telangana is “Research to Innovation; Innovation to Industry; Industry to Prosperity”. The industrial policy framework will be driven by the slogan of “In Telangana—Innovate, Incubate, Incorporate”. The policy framework intends to provide a business regulatory environment where doing business would be as easy as shaking hands. Innovation and technology will drive the industries of the Telangana State.

The new Telangana State Industrial Policy is rooted in certain core values, as follows¹:

- The Government regulatory framework shall facilitate industrial growth
- Entrepreneurs will thrive in a peaceful, secure and progressive business regulatory environment
- Industrial development will lead to massive creation of jobs benefitting local youth
- Industrialization shall be inclusive and facilitate social equality
- Benefits of industrialization should reach marginal and socially disadvantaged sections of the State Environment will be protected and any potential impacts shall be mitigated

Within the framework of the Telangana State Industrial Policy, the present policy document addresses the need for consideration of Climate Change Adaptation (CCA) and its integration into the existing industrial policy.

1.2 Negative Impacts of Climate Change Adaptation

Industrialisation plays an important role for the economic growth of India and has increased strongly over the past decades. At present, industries and industrial estates are facing various challenges that are, on the one hand, imposed by market, supply chain, finance and insurance, and on the other hand, industry and industrial estates are affected by policies and regulations, infrastructure deficiencies, environmental adversities and pressures from nearby communities. ***These pressures are likely to be aggravated by the effects of climatic changes, i.e. related to extreme weather events as well as slow onset changes.*** The projections on the future climatic conditions indicate a further rise in mean and maximum

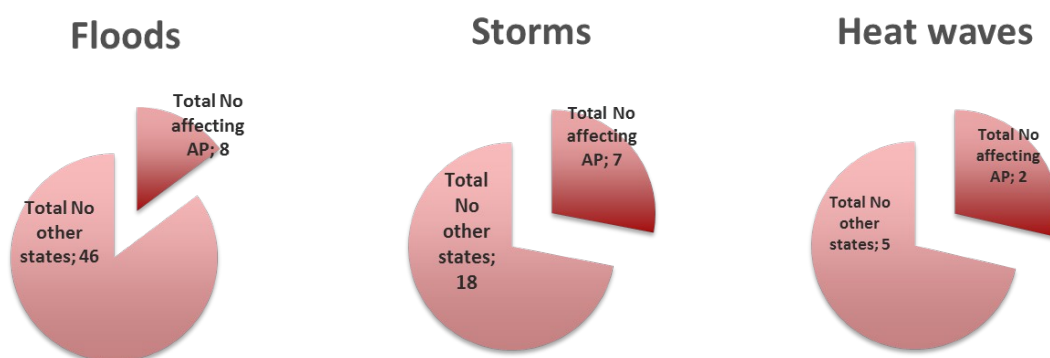
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temperatures, further changes in rainfall patterns, increased stress on water resources, alterations in cyclone intensity and rising sea levels.

For the State of Telangana, there is already **existing evidence** of such changes and resulting negative impacts on industrial production. Both, the States of Andhra Pradesh and Telangana, can be viewed as strongly affected by certain climatic hazards in comparison to other Indian States as depicted by below figure (SWISS RE, 2005-2015).

Figure 1: Number of climatic hazards in Andhra Pradesh (including Telangana) in national comparison (for 2005-2015)

Source: Own analysis based on SWISS RE Sigma Reports 2005-2015



Climate change has the potential to exacerbate limitations imposed by availability of natural resources to ensure livelihoods and further economic development in mid- and long-term. The most prominent example in this respect are limitations of the availability of freshwater, both surface and groundwater, which can be expected to be further aggravated by the impacts of climate change in terms of raising temperatures and changes in rainfall patterns in combination with further growing demands. In consequence, water availability can even restrict energy supply through shortcomings in hydropower generation and cooling water supply.

Industries and industrial areas **are affected by climate change impacts directly or in an indirect way**, i.e. through other systems. Already now, climate variability and extreme weather events provoke considerable losses in the industrial sector: direct damages to industrial estates and infrastructure are caused e.g. through storm events or inundations. In addition to that, industries are negatively affected by climate change impacts that lead to a reduction of productivity and disrupt industrial processes. Extreme weather events such as heat waves threaten the employees' health and reduce the number of working days, thunderstorms lead to fires and blackouts and drought periods limit the availability of water resources. The latest heat wave in summer 2016 severely hit Telangana with maximum temperatures of 45 °C and at least 317 reported deaths (Times of India (2016)). This was only one year after the 2015 heat wave stroke Telangana, causing at least 340 deaths (First Post India (2015)) and heat wave alerts being released by the State governments. Heat conditions reduce labour productivity and for India an impact of four to six percent of work hour loss per year is expected already by 2025 with heat-prone States like Telangana probably being affected severely (UNDP (2016), p. 18). Changing precipitation regimes are also recorded in Telangana where a decreasing rainfall trend was observed in for the months of June and July whereas rainfalls significantly increased in August during 60 years of

observation (1941 – 2000). Such alterations have a direct impact on the availability of water, also for industrial purposes (IMD (2010), 33ff.).

In a broader sense, collateral climate change effects on supply chains, the wider market as well as finance and insurance are also susceptible to affect industries and industrial sites.

In general, potential climate change impacts are determined by a combination of the exposure to the climatic drivers based on location and the specific characteristics of the industry or estate that make it susceptible or fragile. It is oftentimes the latter, ***non-climatic aspects of the system, which contribute strongly to the overall vulnerability***. Climate change adaptation (CCA) targets these non-climatic components of the systems as well by building resilience against the exacerbating effects of climate change. Therefore, ***climate change adaptation is vital for sustainable industrial development²***.

1.3 The policy gap

TSIIC establishes climate change adaptation of industrial areas as a distinct field of action to address the existing policy gap.

There are several policies at different levels in India that are of relevance to identify the gap:

- (a) ***At national level***, the broad policy framework on environment, climate change and sustainable development is defined by the ***National Environment Policy*** (MoEF, GoI, 2006). The policy mentions climate change adaptation ***but does not directly address CCA for industry***.

India's current development paradigm is focussing on sustainable growth aiming to exploit the co-benefits of addressing climate change along with promoting economic growth ((MOEF&CC, GoI, 2016), p. 7). Combatting Climate change is governed by ***India's National Action Plan on Climate Change (NAPCC)***, being implemented through eight ***National Missions*** and a series of policies like renewable energy, solar, wind, coal, energy efficiency, transportation, smart cities etc. contributing to climate mitigation by reducing or avoiding GHG emissions. Out of the four ***new National Missions*** that are under discussion for the NAPCC, the proposed ***Waste-to-Energy Mission*** would also be pertinent for larger industries which generate large amounts of waste which can be used to harness energy from waste thus lowering the state's dependence on coal, oil and gas, for generation of electricity. ***However, measures directly supporting CCA are not yet considered mandatory or eligible***.

The ***Nationally Determined Contribution (NDC)*** declared by India in 2015 and ratified on October 2nd, 2016, highlights the importance of industry and industrial areas for mitigation strategies, e.g. enhancement of energy efficiency and abatement of pollution (MOEF&CC, GoI, 2015). ***However, the NDC does not encompass industry in the proposed adaptation strategies especially in water management and disaster management aspects***.

Efforts are made to integrate and align climate change adaptation with Disaster Risk Management (DRM) and Disaster Risk Reduction (DRR). While earlier guidelines of the National Disaster Management Authority (NDMA) address aspects of CCA rather indirectly as part of disaster mitigation, the ***National Disaster Management Policy*** (2009) recognises and promotes the synergies of DRR and CCA. The National Institute of Disaster Management (NIDM) also builds on these synergetic effects (NIDM, 2014 a). The ***National Disaster Management Plan*** (2016) underpins the important role of industrialization for vulnerability but remains unspecific regarding CCA. In some ***NDMA***

² Wherever possible, climatic issues should not be addressed in isolation – TSIIC will therefore only implement CCA measures that are climate-neutral or even provide room for GHG reduction; strong links with climate change mitigation and resource efficiency options will be explored.

and NIDM guidelines, manuals and training modules, e.g. on cyclones, floods and landslides, industry and its vulnerability to increasing hazards are mentioned, **but to date there is a general lack of policies regarding CCA in the industrial sector.**

The Government of India (GoI) has recently established the **National Adaptation Fund on Climate Change** (NAFCC) to assist Union States that are particularly vulnerable. Financing is provided based on the needs and priorities identified under the State Action Plans for Climate Change (SAPCC) and the relevant Missions under NAPCC. Hence, **CCA of industry is not yet within the direct scope of the NAFCC** but is indirectly related to NAPCC missions such as the **National Mission on Strategic Knowledge for Climate Change** and the **National Water Mission**. This means that GoI provides funding for developing quality environmental infrastructures in industrial areas in accordance with specific guidelines promoting pollution reduction and various schemes.

The notification for **Environment Impact Assessment** (MoEF, GoI, 2006) similarly to other environmental legislation emphasises abatement and reduction of pollution, **but does not cover aspects of adaptation measures.**

Also the **Draft National Water Framework Bill (2016)** currently under discussion **indirectly comprises CCA** by requiring industrial water management through water efficiency and pollution reduction (MWRRD&GR, GoI, 2016), Ch. VI, 25). The **Draft Model Bill for the Conservation, Protection, Regulation and Management of Groundwater** is under discussion, which also **indirectly comprises CCA** through pricing of industrial and bulk use of groundwater (Planning Commission, GoI, 2016, Chapter IX, 21 and Chapter VIII, 26).

- (b) **At state level**, the **State Action Plan on Climate Change** (SAPCC) of Telangana State identifies the industrial sector as one of the ten major sectors in Telangana State that are seriously impacted by Climate Change. However, no adaptation activities for industrial sector were identified. **The SAPCC focus on mitigation activities, although some of which could be linked to CCA.**

The **Industrial Policy Framework for the State of Telangana** (Government of Telangana, 2014) and the **Incentives for setting up New Industrial Enterprises in the State of Telangana** (Industries and Commerce Department, GoTS, 2014) encompass cleaner production and sustainable green measures as core values of the industrial policy. Two out of 14 major sectors comprises of Waste Management & Green Technologies and Renewable Energy & Solar Parks covers some of the aspects of CC. The policy also indicates promotion of Common Effluent Treatment Plant for treatment of effluents. The policy also indicates promotion of skill development and cleaner technologies through incentive schemes. **However, there is no reference to CCA is made in the policy guidelines.**

GoTS financially supports infrastructure projects and the up gradation of infrastructure facilities such as water supply, electric sub-stations, laying of roads or effluent treatment plants in the existing industrial estates. **However, support for climate change adaptation aspects is not explicitly specified.**

In summary, the policy gap relates to the following:

- So far, national CCA policies such as the NDC and the NAPCC as well as Telangana's state level SAPCC do not or only indirectly encompass industrial aspects.

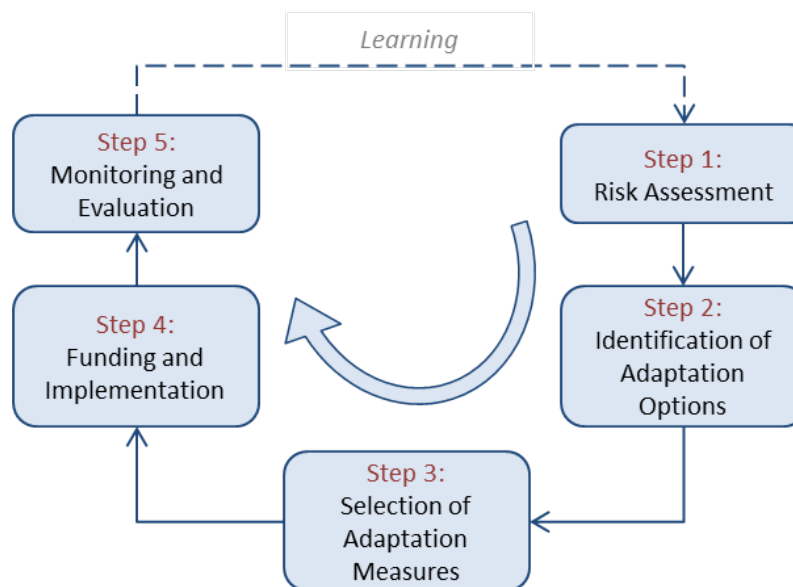
Relevant environmental policies that apply to industry such as the Notification on Environment Impact Assessment or the National Disaster Management Plan fall short in including CCA aspects. As for the case of

- Telangana State, so do the Industrial Policy Framework and the Incentives for setting up New Industrial Enterprises in the State of Telangana.

TSIIC therefore establishes climate change adaptation of industrial areas as a distinct field of action to address the existing policy gaps as summarised above.

Overall approach - the process of adaptation

TSIIC understands adaptation to climate change as an iterative development process including the following steps:



- **Step 1: Risk Assessment**

According to ISO 31000, risk assessment includes risk identification, risk analysis and risk evaluation. Risks from climate-related impacts arise depending on how climate-related hazards concur with exposure, vulnerability and sensitivity of human, technical or natural systems. In the case of the adaptation process for industrial areas, the initial risk assessment needs to identify the relevant risk types for each site, quantify the expected impacts in relation to exposure and susceptibility, analyse the resilience of the site and assess the likelihood that the risk will occur.

- **Step 2: Identification of Adaptation Options**

Depending on the risks identified during risk assessment, a variety of possible adaptation options is identified aiming at minimizing these risks.

- **Step 3: Selection of Adaptation Measures**

From the set of identified adaptation options, specific measures are selected and prioritized³.

- **Step 4: Funding and Implementation**

For the selected adaptation measures sufficient funding must be allocated in order to start the implementation phase.

- **Step 5: Monitoring and Evaluation**

After implementing the adaptation measures a concise monitoring and evaluation of the measures' effectiveness and performance is necessary.

- **Learning Process (Feedback mechanism)**

³ CCA measures with a negative effect on the climate will not be implemented and strong synergies with climate change mitigation and resource efficiency will be sought.

In that way potential for optimization as well as shortcomings and deficiencies can be identified using the tools (developed in Manual 1) to further improve the adaptation measures of the specific site and to further improve the various steps of the adaptation process for other industrial areas.

- **Iterative development process**

Last but not least it is advisable to regularly update risk analysis and review adaptation measures in the light of updated climate data and scenarios and technological and social development.

By adopting the above model as standard model for adaptation of industrial parks to climate change TSIIC acknowledges the need to mainstream the concept in its work, structures and processes and to develop respective capacities for its implementation.

2. Purpose and Scope

2.1 Objective of the climate change adaptation policy

The objective of this policy is to provide a top-level management direction on adaptation to climate change for all operations of TSIIC as further specified in the mission statement.

***Mission Statement
on Climate Change Adaptation and Sustainable Industrial Development***

TSIIC substantiates its previous commitment to the development of eco-industrial parks and sustainable industrial development.

The objective to promote and advocate for effective and consistent adaptation to climate change is integrated into the corporations' identity, vision, mission and activities.

TSIIC acknowledges and emphasizes adaptation to climate change and disaster risk management as key elements of both all types of industrial areas and sustainable industrial development.

TSIIC supports the formulation and implementation of a regulatory framework for climate change adaptation of all types of industrial areas with respect to content and information and motivation of industrial stakeholders, and monitoring of results.

TSIIC understands climate change adaptation as a key element of good governance in general, and for sustainable industrial development in particular.

TSIIC establishes and follows a standard for eco-industrial parks and climate change adaptation and integrates all the aspects of climate risk analysis and related adaptation measures.

2.2 Mainstreaming climate change adaptation of industrial areas into the planning and management procedures of TSIIC

TSIIC commits to address the following areas:

1. Integration of climate change adaptation in the overall mandate of TSIIC through adoption of this policy and the above objectives thereof

TSIIC substantiates its previous commitment to developing eco-industrial parks and sustainable industrial development. Promotion for and work towards climate change adaptation form an integral part of the corporation's identity, vision and mission and adaptation to climate change is understood as a key element of good governance in general and for sustainable industrial development in particular. A first step to achieve this is taken with the adoption of this policy. The corporation's vision and mission will be amended accordingly within the next **01 year**. Regular reviews and additional recommendations of the policy will be done every year.

2. Mainstreaming of climate change adaptation into the institutional setting of TSIIC

Mainstreaming of CCA into the institutional setting is the core element of the actions triggered by the adoption of the policy. This includes the following matters:

- **Institutional set-up**

Climate change adaptation needs to be an anchor point in the organizational framework of TSIIC to make the organisation fit for the efficient promotion and realization of climate change adaptation. This will be achieved through formation of a dedicated CCA unit such as a cell or a responsible department within the existing institutional framework by appointing field experts and external consultants who have specialized knowledge of the domain. The department will be staffed with an appropriate set of positions and qualifications and provided with necessary equipment and budget. A respective table of organization will be put in place within the next 03 years. Climate change officer to be allotted for each zone, and he/she will coordinate with cross-cutting department of IICs. Staff and financial resources for implementation during the next 3 years will be allocated.

- **Formulation of policy directions, guidelines and standard operational procedures**

For key actors within TSIIC, policy directions concerning climate change adaptation need to be formulated, adopted and set in force via Standard Operational Procedures within due time.

- The **IIC management** at head office, zonal and industrial area level is responsible for further developing the corporate policy, the general framework for budget allocation and for mainstreaming a defined level of climate adaptation and increased resilience to the impacts of climate change in standards for industrial parks in Telangana State. Furthermore, IIC management's task is to communicate, promote and work towards CCA towards industrial associations, key stakeholders and the broader public.
- **Data Managers (Management Information System)** should collect the data on impact of extreme climate events such as floods, water stress, etc. on industries and industrial parks, this may include infrastructure damage, loss in production, etc. The data to be collected by the respective zonal office where the impacted industrial park is located and transfer to head office.
- **Planners** shall incorporate climate change adaptation into the development of all types of new industrial areas, their organisational setting and their operational procedures. They also need to address adaptation and retrofitting of the existing parks through compilation of Climate Change Action Plans coherently addressing increased resilience of existing industrial parks via technical refurbishment and energy efficiency improvements, adoption of adequate management and maintenance procedures, as well as active involvement of local industries pushing and supporting them in planning and proceeding with their own adaptation measures.
- **Engineers** need to guide the technical implementation of adaptation measures in industrial areas.
- **Financing** shall provide incentives for the development of new climate resilient industrial parks and needs to support financing of adaptation measures in existing parks. TSIIC promotes private investments through various business models in win-win situation and promoting CCA measures (in industrial parks) as a component of Corporate Social Responsibility (CSR) measures under the CSR Policy (as per Company's Act 2013).
- **Annual work plans** shall include at least a 50% climate proofing of investments (project Indicator 3); this climate proofing is to be achieved via the Climate Risk Assessment method.

TSIIC will adopt guidelines and Standard Operational Procedures (SOP) integrating climate change adaptation in the planning procedure for new industrial areas and establishing a procedure for establishing a Climate Change Action Plan for existing industrial areas.

- **Industrial Area Local Authorities supporting adaptation to climate change**

Industrial Area Local Authorities are the key actors at local level to promote and implement CCA in the single industrial area. Therefore, IALAs need to be developed to be able to do so. The role of Zonal Managers and Zonal Offices is to support the IALAs in this undertaking. IALAs can support CCA in existing parks, e.g. through internal accruals or the incorporation in building approvals. The existing IALA guidelines should be amended and updated to create mandates for inclusion of CCA planning for existing IPs in the form of periodic reviews to be conducted. For new IPs, EIAs and adherence to specified building codes, waste management strategies, energy efficiency improvements etc. should be prerequisites for securing building and operational approvals. TSIIC will develop the respective capacities and competencies under the framework of the capacity development programme within the next 03 years. The IALA guidelines need to be updated to promote CCA in the industrial parks and industries.

3. External communication and promotion of climate change adaptation and sustainable development

Successful adaptation to climate change cannot be achieved through IIC-internal actions only. TSIIC takes the stake and promotes adaptation to climate change and sustainable industrial development in the context of their work, i.e. in communication with authorities, industries, and entrepreneurs, their associations and last but not least policy makers and the public. TSIIC should be actively engaged in creating general awareness through continuous engagement with all the involved stakeholders including policymakers, regulatory authorities, allied industrial associations, labour unions, employees in the IPs as well as the general public residing around the IPs to ensure that the concerns of all are addressed.

- **Cross-sector dialogue on CCA**

TSIIC will promote discussion and exchange on CCA with other strategic sectors, stakeholders, partners, and government departments. Inter-departmental collaboration and integrated planning efforts would ensure holistic CCA Planning by promoting increased collaboration and exchange of ideas amongst all relevant stakeholders to minimize duplication of efforts and promote complementarity of actions leading to cost-effective implementation.

- **Promotion of CCA financing approaches**

Policy discussion and decisions on integrated and sustainable approaches for financing of adaptation to climate change in industrial areas and single industries will be promoted by TSIIC as will be the availability of up-to-date information and data on climate change and adaptation to climate change for industries and industrial sites. TSIIC will work for the development of appropriate financial products including insurances targeting adaptation to climate change in industrial areas and in individual industries.

3. Guidelines, Instruments and Tools

TSIIC will adopt guidelines, procedures and tools developed under the GIZ cooperation project “Climate Change Adaptation of Industrial Parks in Andhra Pradesh and Telangana State” (CCA project). All relevant documents are listed in the front chapter called “climate change adaptation document series”.

As per the CCA project Indicator 3, **at least 50% of the future investments in the industrial areas need to be climate-proofed**. The following will support in reaching this goal:

3.1 Development of new industrial areas

TSIIC already applies a dedicated procedure for planning and development of new industrial areas. Adaptation to climate change will be mainstreamed into this procedure as integral part.

The “Guideline for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change” and the respective “Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change” describe the various steps of a climate vulnerability and risk analysis and subsequent identification and planning of adaptation measures in detail. This methodology will be made mandatory for all planning of new industrial areas in Telangana State. Findings and recommendations of both, the vulnerability/risk analysis and planning of adaptation measures, will be duly considered during internal decision making in TSIIC. An explanatory chapter/report on adaptation to climate change for the new industrial area will be an integral part of the Detailed Project Report (DPR) and the Master Plan.

TSIIC will advocate for making climate vulnerability analysis and climate adaptation plans/measures mandatory elements of the DPR and the Master Plan for new industrial areas. Making CCA aspects and their sufficient consideration in the proposed plans mandatory for granting approval is a good way to ensure that CCA requirements are fulfilled. It is important that **clear adaptation related criteria for obtaining approvals** are established in the near future.

Furthermore, vulnerability assessment and risk mitigation and adaptation to climate change shall be made mandatory for industries settling in the new park. In a first step, TSIIC will clearly communicate existing adaptation needs to industries and provide advice and support for identification, planning and identification of appropriate financing instruments. At a later stage, based on lessons-learnt, TSIIC will define the minimum benchmark to be met by the industries in the industrial area.

3.2 Upgrading of existing industrial areas

Adaptation to climate change in existing industrial areas is a completely different process. The “Guideline for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change” developed by the CCA-Project includes a dedicated procedure to analyse vulnerability and risks in an existing industrial area and to deduct and plan adaptation measures thereof.

After being tested and adjusted TSIIC will adopt this procedure and make it mandatory for establishing a CCA Action Plan for existing industrial areas in Telangana State.

Based on a preliminary rapid risk screening of all industrial areas in the state, TSIIC will establish a priority list of industrial areas to be adapted to the impacts of climate change. The

priority list will be supported by a dedicated action plan indicating timing and allocating manpower and financial resources to establish the respective CCA Action Plans and ensure their implementation. The priority list including allocation of resources will be established and set in force until end of 2017.

Upgrading of infrastructure can generally include hard, soft and green-blue measures. The decision on upgrading specific infrastructure work lies with the IALA and, depending on the project volume, administrative and technical sanctions and approvals from Deputy Zonal Managers (DZM), Zonal Managers (ZM), Managing Directors (MD) and Chief Engineers (CE) are required. In planning of infrastructure works, decisions and sanctions, aspects of adaptation to climate change shall be an important rationale in future. Guidelines and tools for planning adaptation of existing industrial areas are valid in this respect as well and will be made mandatory by TSIIC.

3.3 Operations and maintenance of industrial areas

Adaptation to climate change is to be anchored not only in planning but also in operations and maintenance (O&M) of industrial areas.

When establishing new industrial areas operation & management guidelines for the IALA and the service society need to include aspects of adaptation to climate change to ensure building of energy efficient building and pollution control measures. The respective chapters of the guideline will be adopted by TSIIC and made mandatory elements of the O&M manuals.

In both, new and existing climate resilient IPs, adequate **monitoring and evaluation** after the implementation of adaptation measures also need to be ensured.

4. Financing of Climate Change Adaptation Measures

Adequate mobilisation of financial resources will be decisive for successful adaptation of industrial areas to climate change in Telangana State. Various mechanisms will be applied for new industrial areas, existing ones and their O&M.

For **new industrial areas** minimisation of vulnerability and risks and maximisation of resilience are key features to ensure long-term economic, social and environmental sustainability of the undertaking. Hence, the required works are considered as standard and shall be included in the development costs, and hence, be passed to the final selling / lease price.

For **existing industrial areas** minimisation of vulnerability and risks and maximisation of resilience are an add-on; however, definitely also ensuring long-term economic, social and environmental sustainability of the industrial area and reducing risks for the individual industries. Hence, costs for adaptation measures shall be shared between TSIIC and the individual industries. Adaptation planning and measures in the realm of industrial area, such as storm water management on public ground or common infrastructures shall be financed by TSIIC and will be specifically provided in annual budgets. However, at the same time individual industries shall take complementary measures on their side to further reinforce the resilience and adaptation. The adequate balance between public and private investment shall be agreed between both parties for each CCA Action Plan. In any case, TSIIC will support the industries to identify adequate means and products to secure financing^{4, 5}.

In their **financial planning for infrastructure works (O&M)**, IALAs have the possibility to allocate funds particularly to projects that take into account aspects of climate resilience and adaptation to climate change. With the prioritization of planned works to receive funds, those proposals that contribute most to climate resilience of IPs shall be preferably selected and linked with available funds. Likewise, proposals that fail to take into account resilience aspects shall be revised accordingly in order to receive funding.

To adequately support and promote measures increasing climate resilience of industrial areas in Telangana State/TSIIC will take the following steps:

- **Earmarking funds**

On top of mainstreaming CCA aspects into investment decisions (i.e. 50% climate proofing), additional funds need to be earmarked for specific CCA measures. **10% of financial resources available** for refurbishment and upgrading of industrial areas will

⁴ **Gujarat State Industrial Policy 2015**, introduced Financial Schemes & Support for Environment Improvement Projects under Gujarat Industrial Policy- 2015 & Others (GoG, 2015), covering financing and incentive schemes for environmental infrastructure such as CETP, online monitoring system, waste management including schemes for reuse and recycle of waste, promotion of green estates, etc., with certain upper limit in terms of both percentage or absolute numbers. For example, the assistance for common environment infrastructure will be up to limit of 25 % of eligible fixed capital investment in the project for the activities and maximum up to Rs. 50 Crores.

⁵ Recently, (TOI, November 23, 2016), **Uttarakhand Government** has decided to deploy one percent of total budget of each of its 66 department towards CCA measures.

be directly allocated for distinct adaptation measures increasing climate resilience of industrial areas; these measures also have to be climate-neutral (Annex 1 specifies potential CCA measures). Allocation of funds will be closely monitored and actions will be taken to ensure spending of the sums reserved. Furthermore, TSIIIC will provide advisory services and support to the Zonal Offices and the IALAs to start respective planning and implementation processes.

- **Grants and Incentives**

There is a need to incorporate and promote CCA measures through incentives. Government can promote CCA measures through existing infrastructure up gradation schemes like the Critical Infrastructure Balancing Scheme (CIBS) and other state government schemes.

Tax benefits to promote new technologies and concepts should be encouraged and import duties on sustainable technologies are to be promoted.

- Introducing Tax subsidy and reducing import duties on Climate friendly technology
- Reducing or removing the service taxes of CETP or waste management promoting reuse / recycle, other service offered in adaptation measures
- Incorporate CCA as one of the components of Corporate Social Responsibilities (CSR) initiatives.

- **Instruments and products**

In order to pull further implementation of climate adaptation measures TSIIIC will seek cooperation with the financial sector to mobilize respective resources and to develop financial products especially targeting adaptation measures in industrial areas and individual industries. Government and Central Banks can create market by introducing Debt-Based and Equity-Based Instruments, which specifically aim to lower the risk of lending to and investing in green investment, thereby attracting lower cost-of-capital finance from the private sector.

- **Resource Mobilisation**

Last but not least, TSIIIC will seek further donor cooperation to mobilize funds for financing climate adaptation measures in industrial areas and individual industries. This may include climate financing for larger projects or project bundles (e.g. GCF) and also **Technology Development & Modernisation Fund Schemes** (TD&MD) of Ministry of Micro, Small & Medium (MS&ME), Govt. of India for technology up gradation / resilience of IPs, also to encourage existing industrial units in the sector, to modernise their production facilities and adopt improved and updated technology so as to strengthen their export capabilities, NCEF for implementing projects relating to innovative methods to adopt to clean energy technology and R&D, PAT mechanism.

5. Capacity Development Strategy for Adaptation to Climate Change

Capacity development targets the following levels and aspects (please also refer to chapter 2.2 for more details on mainstreaming CCA aspects into TSIIC):

Individual level:	
Standards and criteria, e.g.: <ul style="list-style-type: none"> • TSIIC management decided and well-communicated which standards and criteria are to be followed • Relevant officers are capacitated to apply relevant standards and criteria 	Methods & tools, e.g.: <ul style="list-style-type: none"> • TSIIC management decided and well-communicated which methods and tools are to be followed • Relevant officers are capacitated to apply relevant methods and tools • The methods and tools are made available through the “Guidelines” document
Organizational level:	
Procedures and processes, e.g.: <ul style="list-style-type: none"> • The “Guidelines” document encompasses exemplary procedures and processes including CCA. • Additional processes of TSIIC are to be checked for climate relevance by TSIIC and CCA aspects are to be included. • All relevant staff is to be trained on the amended guidelines. 	Organizational strengthening, e.g.: <ul style="list-style-type: none"> • The organisational procedures encompass all relevant CCA aspects (what, who, when). • A responsible CCA unit (such as a “cell” or “responsible department”) is to be established

5.1 Capacity development at individual level

To achieve the above capacity development outcomes **at individual level**, a training and awareness raising programme is being carried out.

Training and skills development: Internal capacity development for climate change adaptation and related to sustainable industrial development has to be provided to TSIIC staff members and local level officials from Industrial Area Local Authorities (IALA). A series of training programmes will be conducted to raise awareness and increase skills of TSIIC in CCA implementation:

- Short duration awareness raising workshop for high-level officials
- Longer-term training programme for relevant staff (including hands-on training); this staff then mentors other colleagues

A training needs analysis and basic capacity development programmes have been developed in cooperation with GIZ and international and national experts. The capacity development programme will be tested in the near future.

For long-term capacity development and implementation of the training programme for its staff TSIIIC will seek long-term cooperation with an Indian training institute. Training materials will be published jointly.

Furthermore, TSIIIC will support and promote development of a professional certification scheme for certified Safety & Climate Resilience Officers, working on planning, implementation, management and supervision of climate adaptation in industrial parks. TSIIIC will seek support from key actors from government and private sector for this purpose.

Awareness programmes: Awareness generation on Climate Change during a one-month long Industrial Environment Improvement Drive among all stakeholders at the park level (i.e. including individual industries and adjacent municipalities) can be effective in promoting CCA measures.

5.2 Capacity development at organisational level

At organisational level, working groups have to be established, that anchor the above required organisation development within TSIIIC. The yet-to-be-established “CCA unit” (such as a “cell” or responsible department) will be a key driver in that process. The CCA Division / Cell can be headed by Chief Engineer. Under whom General Manager (CC) will be responsible for overall activities of Climate Change related activities in the organization. Two Climate Change officers will be reporting from Head Office and one Climate Change Officer will be allotted to each zone, hence 6 climate change officer will be required for 6 zones. Further, at the zonal level, the climate change officer will be reporting to respective Zonal Manager on day-to-day basis and General Manager at the Head Office.

Bibliography

First Post India. 2015. Mega heat wave kills over 1,400 with majority in Andhra Pradesh, Telangana: The bad news is it will get worse. [Online] 2015. [Quote as of: 30.11.2016.] <http://www.firstpost.com/india/32-ceasefire-violations-on-loc-23-militant-attacks-foiled-bsf-3133146.html>

Government of Gujarat, 2015. Financial Schemes & Support for Environment Improvement Projects under Gujarat Industrial Policy- 2015 & Others.

Government of Telangana. 2014. Industrial Policy Framework for the State of Telangana. *Telangana Industrial Infrastructure Corporation*. [Online] 2014. [Quote as of: 07. 27 2016.] <http://tsiic.telangana.gov.in/pdf/Industrial-Framework-2014-Version-1.pdf> .

India Meteorological Department, IMD. 2010. Climate Profile India 2010. India Meteorological Department. [Online]. 2010. [Quote as of: 09.07.2015.] http://www.imd.gov.in/doc/climate_profile.pdf

Industries and Commerce Department, GoTS. 2014. Incentives for setting up of New Industrial Enterprises in the State of Telangana. *Telangana Industrial Infrastructure Corporation*. [Online] 2014. [Quote as of: 2016. 07 27.] http://tsiic.telangana.gov.in/pdf/2014INDS_MS28.pdf .

Integration Environment & Energy. 2016. *Annexure to Guideline for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change in Andhra Pradesh and Telangana State, India*. Hyderabad: GIZ, 2016.

IPCC. 2014. Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Working Group II. [Online] 2014. [Quote as of: 29. 07 2015.] http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf .

—. **2007.** Glossary to the Report "Climate Change 2007 - Working Group II: Impacts, Adaptation and Vulnerability". [Online] 2007. [Quote as of: 29. 07 2015.] http://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-e-o.html .

MOEF&CC, GoI. 2016. India's intended Nationally Determined Contribution: working towards climate justice. *UNFCCC*. [Online] 2016. [Quote as of: 27. 07 2016.] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf> .

MoEF, GoI. 2006. EIA notification. *Ministry of Environment, Forest and Climate Change*. [Online] 2006. [Quote as of: 27. 07 2016.] <http://envfor.nic.in/legis/eia/so1533.pdf> .

—. **2006.** *National Environment Policy*. Delhi: s.n., 2006.

MWRRD&GR, GoI. 2016. Draft National Water Framework Bill, 2016. *Ministry of Water resources, River development & Ganga Rejuvenation*. [Online] 2016. [Quote as of: 27. 07 2016.] http://wrmin.nic.in/writereaddata/Water_Framework_May_2016.pdf .

NIDM. 2014 b. Proposal for a Capacity Building Strategy for DRR: Mainstreaming Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) into City Development Plans (CDPs). *National Institute for Disaster Management*. [Online] 2014 b. <http://nidm.gov.in/pdf/ncrmp/Deliverable%2012-1.pdf> .

—. **2014 a.** Training Module "Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans". *National Institute for Disaster Management*. [Online] 2014 a. <http://www.nidm.gov.in/PDF/modules/climate.pdf> .

Planning Commission, GoI. 2016. Draft Model Bill for the Conservation, Protection, Regulation and Management of Groundwater. *Planning Commission, Government of India*. [Online] 2016. [Quote as of: 27. 07 2016.] http://www.planningcommission.nic.in/aboutus/committee/wrkgrp12/wr/wg_model_bill.pdf .

SWISS RE. 2005-2015. *Annual Sigma Report*. 2005-2015.

Times of India. 2016. 317 die of heat wave in Telangana this summer. [Online] 2016. [Quote as of: 30.11.2016.] <http://timesofindia.indiatimes.com/india/317-die-of-heatwave-in-Telangana-this-summer/articleshow/52418147.cms>

Times of India. 2016. 1% budget allocation of each govt dept to climate change adaptation [Online] 2016. [Quote as of: 05.12.2016] <http://timesofindia.indiatimes.com/city/dehradun/1-budget-allocation-of-each-govt-dept-to-climate-change-adaptation/articleshow/55586159.cms>

Government of Telangana (2016). Socio-Economic Outlook, [Online]. [Quote as of 05.12.2016]

UNDP. 2016. Climate Change and Labour: Impacts of Heat in the Workplace. [Online] 2016. [Quote as of: 30.11.2016.] http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---gjp/documents/publication/wcms_476194.pdf

UNISDR. 2015. Terminology. [Online] 2015. [Quote as of: 20. 07 2015.] <http://www.unisdr.org/we/inform/terminology#letter-h> .

Annex

Examples of adaptation options for existing / newly planned industry and industrial estates

Color-code for adaptation options for below table is as follows:

Retrofit of existing industrial parks	Newly planned industrial parks	For both (existing and newly planned industrial parks)
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Impact area	Adaptation options [and responsible initiators]
Industry park and industries	
Location	<ul style="list-style-type: none"> Planning procedures and processes for site selection to take into account climate change aspects [Government (planning) / Developer] Train responsible planning agencies / departments on how to identify climate risks and integrate them into their work (e.g. planning, decision making and construction projects) [Government (planning)/ Developer]
Site layout	<ul style="list-style-type: none"> Development and implementation of rehabilitation plans for already affected sites / areas within a site (incl. incentives or compensation for re-settlement for the industries) [Operator of the site with help from the Government] Retrofit green and blue spaces on site to avoid or mitigate heat islands [Operator of the site] Reduction of sealed surfaces; intermediate storage of water in open landscape [Operator of the site]
	<ul style="list-style-type: none"> Plot allotment guidelines taking into account proper zoning and climate change [Developer] Site planning to avoid heat islands by including green and blue spaces and enough space between buildings [Developer] Site planning to include sufficient drainage and run-off areas for rainwater, minimize sealed surfaces; intermediate storage of water in open landscape Developer]
	<ul style="list-style-type: none"> Avoid erosion of slopes (e.g. through planting of scrubs and trees; terracing) [Operator / Developer] Plantations and walls against strong winds [Operator / Developer]
Infrastructure	<ul style="list-style-type: none"> Retrofit drainage systems to cope with flooding [Operator / industries] Exposure reduction through relocation (or elevation) of critical infrastructure (retrofit) [Operator of the site or individual industries in their premises]
	<ul style="list-style-type: none"> Provide appropriate drainage system; separate storm water and sewage systems [Developer] Ensure non-exposed location of critical infrastructure Developer]
	<ul style="list-style-type: none"> Assess the vulnerability of major industrial hubs to climate related risks [Government (agencies on industry, planning, environment & climate change) and industrial stakeholders] Allocate budgetary funds to upgrade of industrial park infrastructure [Government/Developer]

Impact area	Adaptation options [and responsible initiators]
	<ul style="list-style-type: none"> • Installation of decentralised / renewable energy supply; ensure sustainable electricity backup Developer / industries] • Provide sufficient cooling for ICT facilities and production processes [Developer for public buildings during planning, Operator of the site for public buildings, individual industries in their premises] • Install measures to protect infrastructure from flooding [Developer / Operator] • Establish grey and rainwater harvesting, set up own water storage facilities (rainwater harvesting, reuse of treated water), set up alternative irrigation schemes for green spaces (e.g. drip-irrigation, rainwater harvesting, recycling of treated water) Developer /Operator] • Proper maintenance and cleaning of draining channels regularly to allow water to discharge [Operator] • Maintain roads to avoid subsurface erosion [Operator] • Create emergency plans (e.g. also for occurrence of multiple risks at same time) [Government to establish requirement and guidelines/ Operators to implement]
Buildings	<ul style="list-style-type: none"> • Improve the disaster preparedness of storage facilities for hazardous materials [Government (National Government / NDMA providing / amending / updating respective guidelines and standards, state factory inspectorates executing inspection)/Operator /Industries] • Improve insulation of buildings (retrofit), retrofit green roofs [Operator/ Industries]
	<ul style="list-style-type: none"> • Exposure reduction via structural measures (e.g. elevate buildings) [Developer / Industries] • Climate resilient design standards / building codes [Government], specifications for industry buildings on site [Developer] • Proper insulation of buildings; build green roofs; optimise number and size of windows; high thermal mass of walls (best for inside walls to use temperature time delay for heating/cooling); use reflecting or absorbing window glass [Industries / Developer] • Optimise building orientation (i.e. to avoid sun radiation on walls – East/West walls receive most of the low-lying sunshine) [Industries / Developer] • Install roofs that can cope with storms (e.g. 30° roof pitch or appropriate fixation of materials) [Industries/Developer] • Avoid superstructures that are susceptible to vibration from winds (e.g. tall masts) or ensure appropriate fixations [Industries/Developer]
	<ul style="list-style-type: none"> • Shading, ventilation and cooling of buildings to reduce indoor temperatures [Industries / Developer / Operator]
Industrial processes	<ul style="list-style-type: none"> • Exposure reduction through relocation of critical machinery and equipment [Industries] • Adapting cooling capacities for processes and facilities for production processes to expected exposure in time [Industries]
	<ul style="list-style-type: none"> • Exposure reduction through proper location (or elevation) of critical machinery and equipment [Industries]
	<ul style="list-style-type: none"> • Increase water efficiency in production processes; increase re-use quota of water to avoid lack of resources stemming from water shortages [Industries]

Impact area	Adaptation options [and responsible initiators]
	<ul style="list-style-type: none"> • Use renewable energy as decentralised power supply (to reduce dependency on pot. damaged grid) and increase energy efficiency in production processes to reduce energy load in order to install decentralised energy supply [Industries] • Increase resource efficiency in production processes to be less dependent on suppliers that might default during climatic events [Industries] • Include flexibility in production steps [Industries]
Market, supply chain, finance and insurance	
Logistics	<ul style="list-style-type: none"> • Integrate climate change aspects into the risk and innovation management processes of the company (e.g. supply risks) and identify critical components [Industries] • Communicate identified climate risks to suppliers [Industries] • Diversify suppliers to reduce dependency (multi sourcing) [Industries] • Increase storage of critical supplies (to be less dependent on just-in-time deliveries) [Industries]
Stock (on site)	<ul style="list-style-type: none"> • Shade and cool storage facilities [Industries / Developer / Operator] • Provide shelter roofs for external storage areas [Industries/Developer/Operator]
Management & OHS of employees	<ul style="list-style-type: none"> • Establish sound and resilient overall management practices for the industry park that allow for implementation of climate change adaptation aspects and supervision thereof [Operator] • New work practices to avoid heat stress among outdoor workers [Industries / Operator] • Supply of drinking water to staff [Industries / Operator] • Provision of shelter and resilient assembly places for staff [Industries / Operator] •
Market	<ul style="list-style-type: none"> • Diversify products and selling markets to be less dependent on one market that might be affected by climatic hazards [Industries] • Investigate in potential business opportunities through changes in customer preferences (e.g. cooling technologies) [Industries] • Development of climate friendly and resilient products [Industries] • Promote diversified and dispersed industries, including small/medium scale agro processing, to stabilise agricultural livelihoods [Industries]
Finance & insurance	<ul style="list-style-type: none"> • Promote public-private risk reduction initiatives [Government] • Insurance of companies and sites against natural disasters [Industries / Operator] • Communicate good risk management regarding climate change risks to potential investors [Industries/Developer/Operator]
Surrounding communities, wider infrastructure, and environment	
Community	<ul style="list-style-type: none"> • Establish dialogue with the communities on climate related matters (e.g. water usage) [Operator / Developer] • Set up joint early warning systems [Operator / Government]
Policy and regulation	
Policy &	<ul style="list-style-type: none"> • Mandatory environment impact assessments to include climate change aspects ("climate proofing") [Government]

Impact area	Adaptation options [and responsible initiators]
regulation	<ul style="list-style-type: none">• Review of current standards and regulations to take into account climate change aspects [Government]• Review of current funding schemes to include sources of funding for climate change adaptation [Government]• Establish provisions regarding minimum width of buffer zones / no settlement zones around industrial areas [Government]• Ensure compliance with relevant legislation [Industries / Developer / Operator]



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INTEGRATION Environment & Energy
Climate Change Adaptation Project (CCA), 1st Floor, Parisrama Bhavan
Fateh Maidan Rd, Basheerabagh, Hyderabad – 04, Telangana, India
www.integration.org, Tel. +91 (0)40 66184019,

Responsible

Dieter Brulez, Director, CCA

Authors

Peter Bank, Sibylle Kabisch, Dieter Brulez, R. Hrishikesh Mahadev, Rajani Ganta