IRIS
IMPROVE RESILIENCE OF INDUSTRY SECTOR

GUIDELINES
FOR A RESILIENT INDUSTRY

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Summary

Introduction

Climate change determines effects not only in urban areas, where the impacts are more often analyzed, but also in the industrial sphere. Climate change manifests itself in extreme or catastrophic events, such as floods, floods, heat waves or frost, drought, tornados, which cause damage to production sites and industrial plants, causing effects on production and on the company's business.
It is therefore important for companies to equip themselves with tools for assessing and managing climate risk. To enable climate risk management, it is important to codify a method to assess the impact of certain events and plan appropriate responses.
Possible steps are:

- Context analysis
- Definition of climate events
- Definition of risks and damages
- Evaluation of the probability of occurrence
- Evaluation of magnitude
- Risk calculation
- Planning of adaptation measures
- Monitoring of the implementation of the Plan in order to assess the effectiveness of the interventions and the ability to adapt.

In the industrial sector, it is important to identify and assess the impacts of climate change by declining damage and climate risks in various aspects that concern business activity: production, logistics, supply chain, infrastructure, etc. The complexity of the effects of climate change in each of these business areas can only be addressed through targeted planning, which can be carried out both at the plant and cluster scale (industrial area or production chain).

The LIFE IRIS project has developed several useful tools for companies that intend to deal with the threats of climate change through risk analysis and the definition of climate adaptation actions that allow to increase resilience.
Specifically, the tools made available to the industry by the IRIS project concern:

1. A methodology for analyzing and assessing climate risk in the industrial sector.
2. A web platform of free access to companies that allows to analyze the risks induced by climate change and allows to identify adaptation measures and evaluate their effectiveness.
3. An exhaustive list of climate change adaptation actions for industry (with both management and infrastructural solutions).

The various tools developed under the LIFE IRIS project are shown and analyzed below. The project website can be consulted for more details on the project: www.lifeiris.eu.

The Climate Risk Analysis

Climate change can produce impacts on organizations and contexts, which effects vary according to many factors, such as the organizational structure, the activities carried out, the planned investments. Furthermore, the impacts may differ from one another based on the place and time of occurrence, the type, duration and persistence of the same. Therefore, both in terms of organization and context, elaborating an assessment of the risk deriving from climate change is strategic to face the related consequences.

The analysis methodology, developed within the IRIS project, serves to develop a risk assessment linked to climate change, so as to identify both the vulnerability and the opportunities to be exploited, the productive areas and the supply chain under study. The methodology aims to provide the necessary information base in order to identify the possible adaptation measures to be implemented in the aforementioned contexts of the IRIS project to cope with the impacts due to climate change.

The IRIS project has declined the main extreme weather events that can generate impacts on the production system and the areas of damage in which these impacts can occur.

An extreme weather event is an event that is rare in a particular place or time of year. The definitions of the rare word vary, but an extreme meteorological event would be defined in this way if it is rare to an extent equal to or greater than the tenth or ninetieth percentile of an estimated probability density function based on observations. By definition, the characteristics of what is called extreme weather can vary from one place to another in an absolute sense. When an extreme weather pattern persists for a certain period of time, such as a season, it can be classified as an extreme climate event, especially if it produces an average or a total that is itself extreme (for example, drought or heavy rainfall during a season) [IPCC, 2014].

The main events taken into consideration are:

- intense precipitation
- heat waves
- cold spell
- tornadoes
- drought

Each event must be uniquely defined and associated with an indicator that allows it to be measured.

Meteorological parameter	Weather event	Index	Unit of measure	Time step
Temperature	Heat Wave	maximum hourly temperature	°C	Year
Temperature	Cold Spell	minimum hourly temperature	°C	Year
Precipitation	Intense Precipitation	maximum daily cumulative precipitation value	mm/day	Year
Precipitation	Dorught	maximum number of consecutive days without precipitation	days	Year
Wind speed	Tornado	Maximum hourly wind	m/s	Year

Precipitation is measured by the millimeters of rainfall in the unit of time. Extreme phenomena such as floods, floods and landslides are associated with intense rainfall. In the case of snowfall, avalanches. For intense precipitation two indicators are considered:

- *Intense annual precipitation index:* Sum of daily precipitation above the 95th percentile of the daily precipitation statistics on the basic climatological period.
- *Very intense annual precipitation index:* Sum of daily precipitation above the 99th percentile of the daily precipitation statistics on the basic climatological period.

A heat wave is a prolonged period of high temperatures, above the usual values, associated with high values of humidity without ventilation.
The most representative index of heat waves is the Warm Spell Duration Index (WSDI). For the purposes of calculating this index, a heat wave is an event lasting at least 6 consecutive days in which the maximum temperature is higher than the 90th percentile of the distribution of maximum daily temperatures in the same period of the year on the climatological thirty-year period.

A cold spell is a period of time during which the air temperature is unusually low compared to the average temperatures usually experienced in a given region in the same period and with typical persistence characteristics.
The representative index of cold waves is the Cold Spell Duration Index (CSDI). A cold wave is therefore defined as an event lasting at least 6 consecutive days in which the minimum temperature is less than the 10th percentile of the distribution of minimum daily temperatures in the same period of the year on the climatological thirty-year period.

A tornado is associated with wind speed. The classification of tornadoes is based on the empirical detection of damage caused by the Advanced Fujita Scale (1971). As with earthquakes with the Mercalli Scale, the division occurs by degrees of destructiveness of the phenomenon:

Level	Classification	Wind Velocity
EF0	WEAK	105–137 km/h
EF1	MODERATE	138–178 km/h
EF2	SIGNIFICANT	179–218 km/h
EF3	STRONG	219–266 km/h
EF4	DEVASTATING	267–322 km/h
EF5	CATASTROPHIC	> 322 km/h

Drought is an unusually dry period of time, long enough to cause serious hydrological imbalances. There is meteorological drought when the average precipitation in one place is clearly lower than the climatological average (ISPRA).
The most widespread index in Italy is the SPI (Standardized Precipitation Index) which is based on the statistics of precipitation alone. The purpose of the SPI is to quantify the local precipitation in order to make regions characterized by different climatic regimes comparable. Its value indicates how much the precipitation deviates from the norm: positive values indicate a precipitation higher than the average, negative values a precipitation lower than the average. The values can be interpreted according to the following table:

SPI Values	Class
> 2.0	Extremely moist
from 1.5 to 1.99	Very wet
from 1.0 to 1.49	Moderately damp
from -0.99 to 0.99	Near the norm
from -1.49 to -1.0	Moderate drought
from -1.99 to -1.5	Severe drought
< -2.0	Extreme drought

The impacts of climate change on industry concern the following areas of damage:

Buildings, plants, machinery and work tools
In this context, the company's assets are considered, namely the machinery, equipment, factories, technologies, processes and infrastructures. A damaged element is an element that loses its functionality, its efficiency, decreases its level of safety and reliability, requires more maintenance or has a shorter useful life.

Production
This area of damage is represented by the impossibility of carrying out the core business of the activity. This damage implies that the organization is no longer able to maintain the supply of

products and the provision of services at acceptable levels following an episode of crisis (upstream or downstream). As a result of a severe weather event, the damage can be for example:

- interruption or delays in supply, production or distribution
- alteration of the characteristics or non-conformity of the product or service

Legal liability

In this context, the obligations deriving from involvement in environmental crimes at the company or negligent or negligent behavior along the supply chain fall. It typically occurs in payments of damages, in the application of administrative and / or pecuniary sanctions.

Image and reputation

The damage to image and reputation is traditionally considered as a loss of trust (in relation to a product, a service, a brand, a person or an organization, etc.), loss generated as a result of a negative choice or an operational error. The damage can also originate from a supplier or a far-away distributor in the supply chain, and the repercussions can occur locally, nationally or globally. Examples of damage to image and reputation are those generated by stakeholders (citizens, local institutions, companies, suppliers) from widespread phenomena of pollution or other types of accidents that can be traced to extreme climatic events or insufficient safety conditions in the industrial area; or against the effects of communication campaigns that do not adequately consider the issue of climate change.

Market response / Sales

Sales are a business area that can suffer the consequences of an extreme weather event: for example, there may be a termination or a non-renewal of contracts by customers due to the decrease in performance (product or service) that occurred as a result of an extreme weather event; in the same way, companies located in industrial areas could withdraw membership from collective services if the manager is unable to guarantee the quality of the service (following an extreme weather event).

Financial stability

This area includes both the balance sheet balance and the listing on the markets. Some possible damages are for example the need to resort to financing for the repair of damages caused by climatic events, even by the industrial area manager; the need to incur insurance costs (or increased reinsurance costs) for the coverage of climate risks to which the organization is exposed; jeopardizing the "solvency" of the organization, or the ability to "return" to credit lines opened with banks or to pay for supplies; the "flight" of investors (or lack of attractiveness) and consequent lack of financing for the development of business activities, including the possible worsening of the bank rating.

Health and safety of personnel

This area of damage is represented by the employees and their well-being. Several extreme weather events, typically the heat wave, are the cause of a clear deterioration in the health and safety of

workers in terms of working conditions, for example, but also in the increase of illnesses and injuries.

Infrastructures and networks

This area of damage includes area infrastructures (non-corporate), such as roads, power lines, gas pipelines, district heating networks, telecommunications networks, public lighting networks, water and sewer networks, logistics platforms, purifiers, power plants energy production, green areas, parking lots, waste storage areas.

The analysis of the climatic risk allows to determine the events relevant to the area under study and to estimate the extent of the damage caused by these effects.
Through the analysis of the context we proceed to the identification of the targets, the areas of damage and the definition of the extreme events relevant to the area in question.
For each area of damage, an evaluation of the magnitude and an assessment of the probability of occurrence should be made. This probability must take into account both the historical series relating to the individual types of events (eg floods, heat waves) and future scenarios. These scenarios are defined globally by the IPCC, but in some Italian regions they have also been developed by regional ARPAs.
The climate risk is calculated by the product of the magnitude of the damages for the probability of occurrence of the event:

RISK (R) = PROBABILITY (P) x MAGNITUDE (M)

The representation of the risk can take place through a matrix of the following type, considering values of P variable between 0 (low probability) and 1 (high probability) and of M variable between 1 (low) and 5 (high).

Risk assessment for climatic event									
	Heat Wave		*Cold Spell*		*Tornado*		*Intense Precipitation*		*Etc.*
Buildings, plants, machinery	P: 0,85	M: 4	P: 0,7	M: 3	P:1	M: 4	P: 0,7	M: 5	…
	Risk: 3,4		*Risk: 2,1*		*Risk: 4*		*Risk: 3,5*		
Production	P: 0,7	M: 3	P:1	M: 4	P: 0,85	M: 3	P:1	M: 1	…
	Risk: 2,1		*Risk: 4*		*Risk: 2,5*		*Risk: 1*		
Legal Liability	P:1	M: 2	P: 0,7	M: 5	P:1	M: 2	P: 0,85	M: 2	…
	Risk: 2		*Risk: 3,5*		*Risk: 2*		*Risk: 1,7*		
Etc.	…		…		…		…		…

This assessment is aimed at defining climate change adaptation plans, which represent the main climate risk management tool.
The path of climate risk analysis and planning of adaptation measures, on a corporate and cluster scale, can be conducted, at least in a preliminary form (screening), using the CAST tool, developed within the IRIS project.

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CAST – Climate Adaptation Support Tool

CAST is a screening tool to help companies assess their vulnerability due to the risks induced by climate change and allows to identify adaptation measures and evaluate their effectiveness.
The main features of the instrument are:

- Evaluate risks and vulnerability to climate change: the tool analyzes risk taking into account past weather events and future scenarios
- Identify and evaluate adaptation options: the tool allows the identification of appropriate adaptation measures based on the company's main vulnerabilities
- It is a web application: to use the portal it is necessary to register and follow the guided path in the following sections.

The following link http://www.lifeiris.eu/azioni/web-portal/ allows access to the web tool.
CAST has an intuitive interface that sequentially guides the user through the Wizard approach through different modules that can be accessed directly with some sequencing rules.
The main CAST modules are as follows:

- Weather
- Probability
- Damage
- Riscks
- Actions
- Adaptation

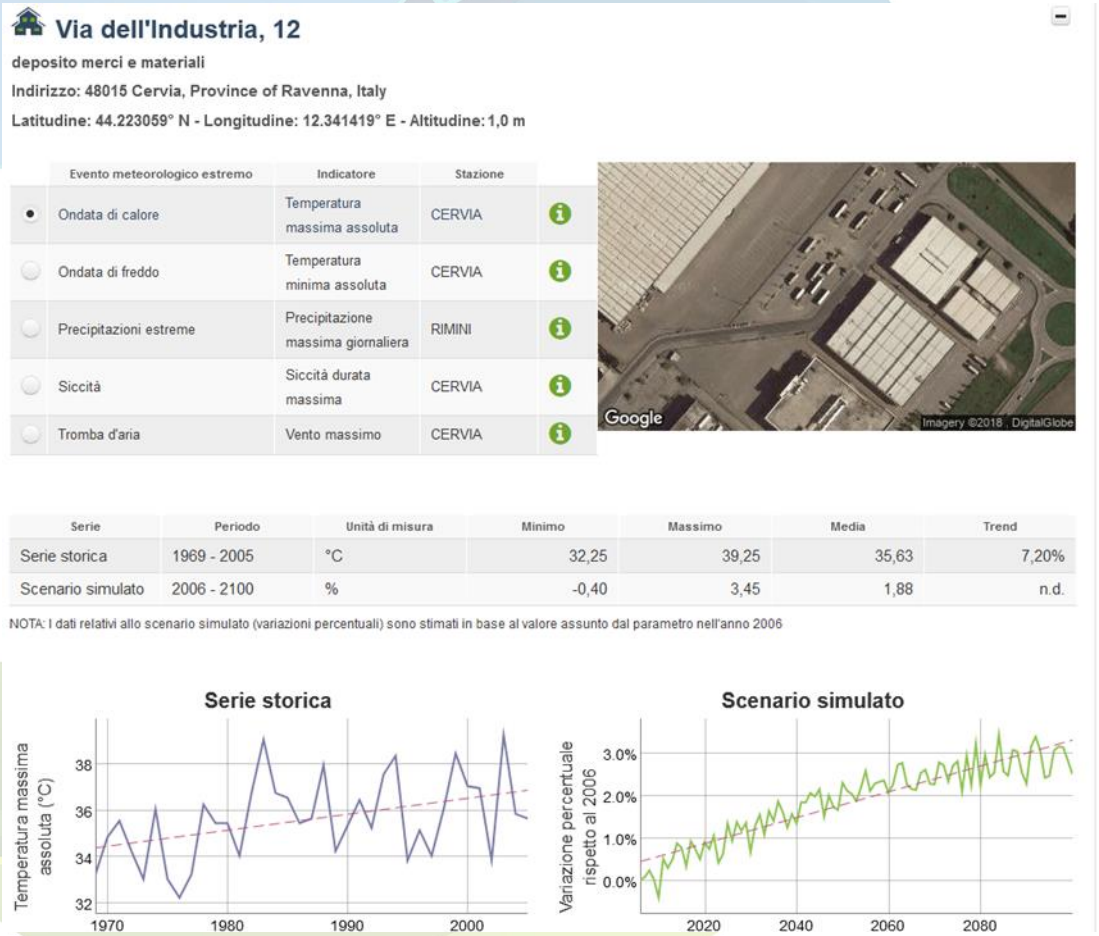
The user can register a company profile to which one or more sites can be added.
Once the company profile has been created and the characteristics of the production site (s) have been entered, the following modules must be filled in to analyze the company's vulnerability and identify adaptation actions:

a) Weather

In this section, a list of extreme weather events is shown for each site: heat wave, cold wave, extreme rainfall, drought and tornadoes.
For each of these extreme events, the following information is provided:

- historical series: this is information on past events; for the Italian territory these data are taken from the ISPRA database (Higher Institute for Environmental Protection and Research) based on the acquisitions of the meteorological station closest to the site in question; for territories outside Italy, the system uses the IPCC (Intergovernmental Panel on Climate Change) database.
- simulated scenario: provides information on the probability of future occurrence based on the IPCC climate forecast data.

The objective of this section is to provide all the available data regarding the climatic situation of the area where the company's sites are located.

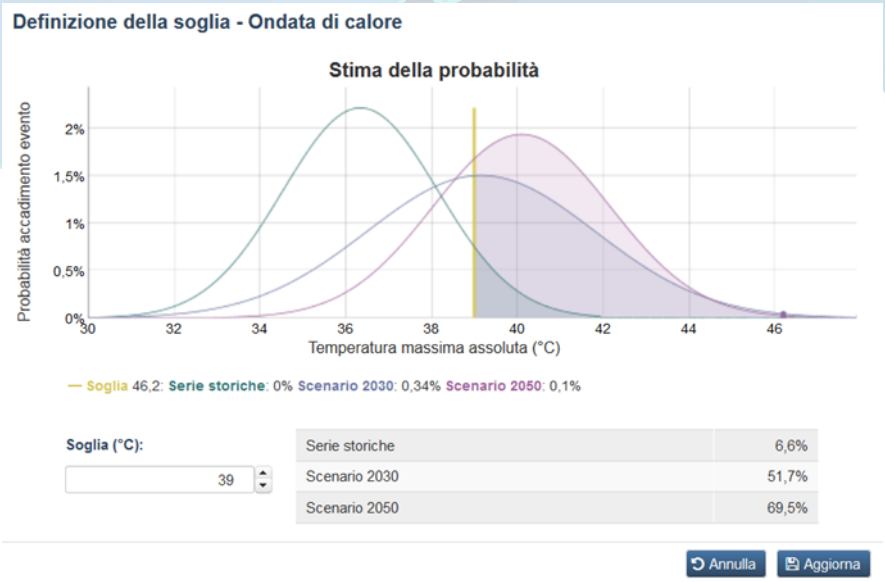


b) <u>Probability</u>

In this section, for each of the sites, CAST provides an estimate of the probability of occurrence of extreme weather events caused by climate change.

For each extreme event, a threshold is provided, which represents the reference value against which the probability of occurrence is evaluated.

All the information available in this section on the probability of occurrence will contribute to the risk assessment.



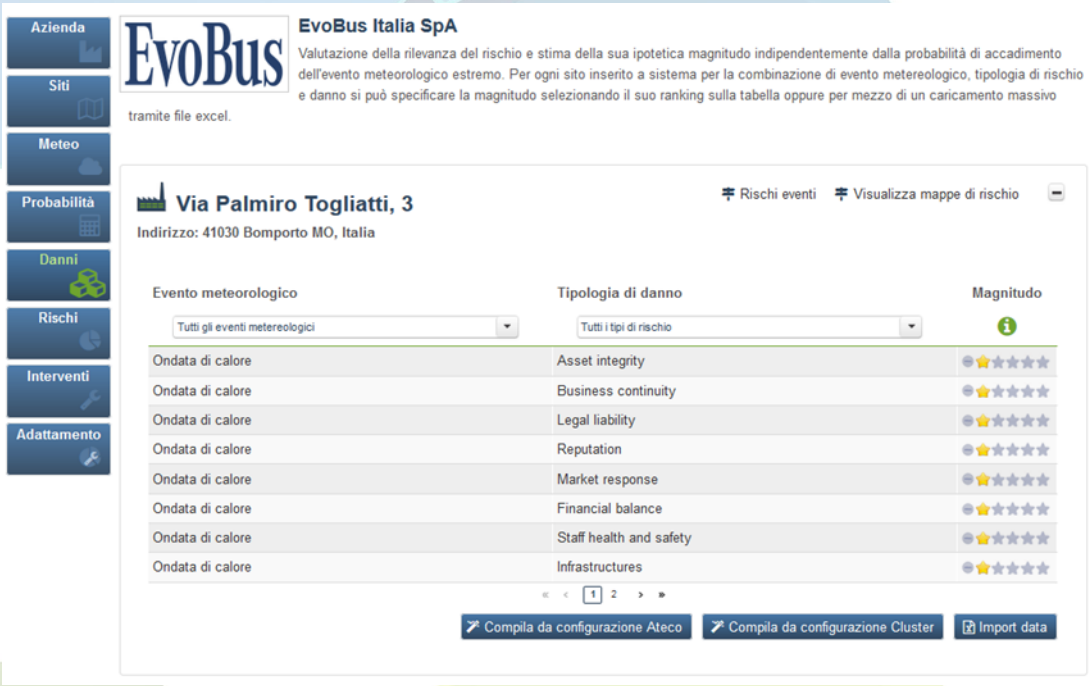
c) *Damage*

In this section, the user must assess the risk associated with each of the selected weather events, regardless of their probability of occurrence.

For each site, for each weather event, a magnitude value will be assigned with respect to each area of business damage, ie each area of the company that can suffer damage.

The entry methods offered by CAST are listed below:

- Manual: the evaluation of the magnitude is done directly by the user.
- Loading an Excel: in order to facilitate the process of assigning the magnitude, the user has the possibility to download an Excel file, fill it in off-line mode and upload it again: the Excel file.
- Compilation from Clusters: this option is active only if, during the registration phase of the company and its sites, the site is declared to belong to one of the Clusters available in the tool; all the magnitude values entered for this site will be compiled based on the configuration of the Cluster to which they belong.
- Compilation by ATECO: this option is active only if the ATECO code is used to describe the site during the registration phase of the company and its sites; all magnitude values entered for the site will be compiled based on the configuration offered by CAST for that particular ATECO code.



d) <u>Risks</u>

In this section the results of the risk assessment are illustrated with graphs and tables, based on the probability of occurrence and the magnitude of each individual meteorological event considered.
In the upper part of the section the overall results for the company appear, in the lower part the results for each site.
The graph generated by the instrument shows the result of the evaluation through a spider chart, which can be visualized with different variables: the damage areas (buildings and plants, production, legal responsibility, image and reputation, etc.) or extreme weather events (heat wave, cold spell, extreme rainfall, etc.).

Additionally, this section shows two additional drop-down lists that allow you to:

- Display different risk values.
- View the risk associated with each individual company site.

Three risk assessments are visible on the spider chart:

- the risk assessed on the basis of historical series
- the risk assessed on the basis of forecasts at 2030
- the risk assessed on the basis of the forecasts for 2050.

While the colored area represents the overall risk, obtained by considering all the variables, a variable is represented along each radius of the spider chart: the length of the data along each radius shows the risk for each variable, therefore it is possible to identify the business area more exposed to risk or the most significant weather event.

Tipologia di danno (massimo)	Serie storiche	Scenario 2030	Scenario 2050
Asset integrity	0,84 R	0,85 R	0,86 R
Business continuity	0,84 R	0,85 R	0,86 R
Legal liability	0,84 R	0,85 R	0,86 R
Reputation	0,84 R	0,85 R	0,86 R
Market response	0,84 R	0,85 R	0,86 R
Financial balance	0,84 R	0,85 R	0,86 R
Staff health and safety	0,84 R	0,85 R	0,86 R
Infrastructures	0,84 R	0,85 R	0,86 R

— Rischio Basso (R < 1)
— Rischio Medio (1 ≤ R < 2)
— Rischio Elevato (2 ≤ R ≤ 5)

e) <u>Actions</u>

In this section, the user can enter for each of the sites present one or more actions aimed at increasing resilience towards extreme weather events.

The web tool allows you to use different ways of identifying adaptation actions, namely:

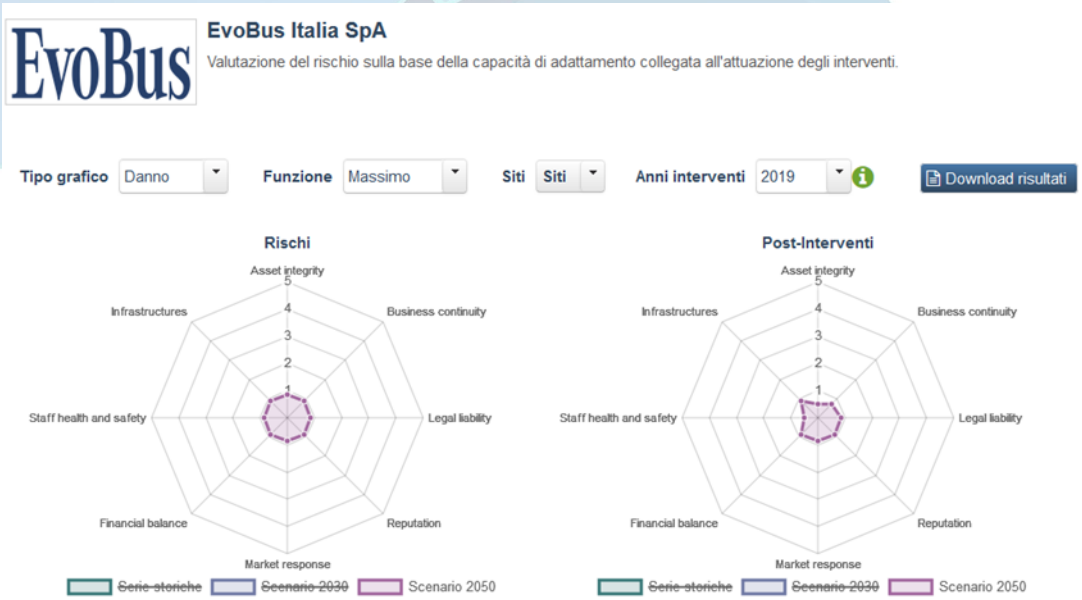
- Use of a predefined list provided by CAST elaborated during the project (system actions).
- Entry of a new action (user action). The user creates an adaptation action based on his needs.
- Use of the Cluster information. This option is active only if, during the registration phase of the company and its sites, the site is declared to belong to one of the Clusters available in the tool; by confirming the choice all the actions validated by the cluster to which they belong will appear as a choice for the user who will have to decide which one to activate.

Each adaptation action must contain:

- the name of the action
- the description of the action
- the type of action ("STRUCTURAL", such as insulation of buildings, planting of trees, construction of flood barriers; "MANAGEMENT - ORGANIZATION", such as the emergency plan, the alert system, the modification of the work shifts: "MANAGEMENT - SUPPLY CHAIN" as awareness of suppliers, selection of suppliers, mapping of critical issues along the supply chain)
- assessment of adaptive capacity, which is understood as the potential of the action to positively affect the site's ability to cope with climate change. The ability to adapt is evaluated on a scale of 5 levels (from 1 = negligible to 5 = very high). Adaptation capacity is provided for each weather event and for damage area.

f) *Adaptation*

In this section the risk assessment (updated on the basis of the adaptation actions inserted: in the upper part of the section a new spider chart therefore shows the risk before and after the implementation of the actions and, if these are considered effective, the user should see an increase in site resilience.



A further feature of the CAST allows you to create a company adaptation report, exportable in a pdf document, which contains all the information entered in the web platform.

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Adaptation Actions to Climate Change for Companies

Through the actions of the LIFE IRIS project it was possible to identify numerous actions for the climate adaptation of companies and the industrial sector. These shares were classified into 4 sectors, ie:

1. Actions that increase sustainability and corporate resilience
2. Actions to adapt to heat waves
3. Adaptation actions to the tornadoes
4. Actions to adapt to heavy rains / floods

The 22 adaptation actions surveyed are listed below.

A. Actions that increase corporate sustainability and resilience

A.1 Drafting Adaptation Plan

Scope	shed and outdoor spaces.
Type of measure	management action.
Description	drafting of a Business Adaptation and Mitigation Plan to climate change, to be implemented in phases over a pre-established period of time.
Advantages	the Plan allows the identification, following a similar analysis to the one reported here, of the actions that the company can put in place to adapt to intense climatic phenomena and to mitigate the consequent possible damage. The Business Plan would allow to plan (technically and economically) both managerial and infrastructural actions tailored to the specific needs of the company and according to the degree of risk identified. The actions should be identified according to the degree of risk that the company decides to accept and the level of potential damage it considers economically sustainable.

A.2 Training operators to manage a state of emergency

Scope	shed and outdoor spaces.
Type of measure	management action.
Description	specific training of personnel and organization of exercises to train staff to manage the emergency and implement all the management actions that serve to mitigate the impact of intense weather events. Possible training actions include: fitting the gates and switching off some machinery in the event of a potential flood, protecting the materials in the event of strong winds, etc.
Advantages	training and preparing personnel on risks related to climate change and on emergency management procedures allows them to maintain a more natural behavior in case of need for evacuation and to achieve greater effectiveness in the preparation of manual protection measures.

A.3 Establishes insurance policies for specific risks

Scope	shed and outdoor spaces.
Type of measure	management action.
Description	stipulation of a specific insurance to cover any damage caused by climatic events of exceptional magnitude.
Advantages	the activation of a dedicated insurance would make it possible to transfer / cover the risk for damage from climatic events that cannot be reduced by direct interventions on company assets. In view of the stipulation of the policy and the revision of the prize, it would be useful to prepare a company Adaptation Plan or to provide agreements within the policy with companies that propose Disaster Recovery plans.

A.4 Emergency plan update and disaster recovery plan

Scope	shed and outdoor spaces.
Type of measure	management action.
Description	updating (if present) of the company emergency plan including the risks deriving from significant climatic events. If the plan highlights critical issues, it is useful to add a plan for the recovery of company functionality (Disaster Recovery) to the emergency plan, which allows the rapid restoration of business activities (production of products and provision of services) in compliance with the safety regulations of the work and environmental.
Advantages	the drafting of an emergency plan and a Disaster Recovery plan allow employees to be appropriately trained to manage emergencies in the best possible way and to minimize the time needed for the company to restart with production / provision of services.

B. Actions to adapt to heat waves

B.1 Shielding surfaces

Scope	shed and outdoor spaces.
Type of measure	infrastructural action.
Description	Arrangement of shielding surfaces in correspondence of the glass surfaces of the older shed.
Advantages	The screens, adjustable according to the degree of irradiation, would allow to mitigate the internal temperatures of the sheds for a better thermal comfort of the working environment.

B.2 Reflective surfaces and / or "cool materials"

Scope	shed and outdoor spaces.
Type of measure	infrastructural action.
Description	Preparation of reflective surfaces (replacement of existing glazing with reflective glass) and application of reflective paints on the roof and on the exposed surfaces. The solution can be combined with the adoption of a coat that guarantees lower air-conditioning costs in the winter season.
Advantages	The reflective materials let the light filter (without removing light from the rooms) but not the infrared rays, which are responsible for overheating the interior spaces. The cost is significantly lower than the adoption of shielding surfaces, but the application must be repeated cyclically every 10-15 years.

B.3 Screening with tree-lined strips

Scope	shed and outdoor spaces.
Type of measure	infrastructural action.
Description	Creation from scratch and maintenance of barriers shielding the sun's rays through the planting of arboreal essences in rows.
Advantages	Increasing the portion of greenery around the industrial area would allow the walls of the buildings to be shielded naturally, locally improving the microclimate outside the company (temperature and humidity) and decreasing the incident solar energy that would contribute to overheating the work environments. The application of a row as a shielding surface lends itself to buildings of limited height and must be provided not too close to the building to avoid damage in case of demolition by strong wind. The presence of rows of trees and other shielding solutions (green walls) can give the company a high aesthetic value.

B.4 Automated management of suction systems

Scope	interior spaces.
Type of measure	infrastructural action.
Description	Arrangement of automated controls for the exchange of air in the working environments according to the internal / external temperature and according to the season.
Advantages	The automated management would allow to regulate the internal temperature of the sheds according to the workers' comfort needs, it would allow to continuously collect information on the ambient temperature and humidity of the work environments according to the season, the work performed and the machinery in operation.

B.5 Personalized clothing

Scope	interior spaces.
Type of measure	management action.
Description	Equipment for workers in clothing suitable for work in particularly hot conditions which helps to make a critical temperature situation in the workplace less burdensome (eg refreshing and cooling clothing).
Advantages	Better working comfort for workers, less injuries.

B.6 Shielding through green walls

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Creation from scratch and maintenance of barriers shielding the sun's rays through the planting of climbing essences on specific supports.
Advantages	Increasing the portion of greenery around the industrial area would allow the walls of the buildings to be shielded naturally, locally improving the microclimate outside the company (temperature and humidity) and decreasing the incident solar energy that would contribute to overheating the work environments. The creation of a green wall as a shielding surface lends itself to buildings of modest height and must be provided not too close to the building to avoid wall moisture phenomena, systematic irrigation of the planted tree species is required in the summer season. The presence of rows of trees and other shielding solutions (green walls) can give the company a high aesthetic value.

B.7 Green parking and draining floors

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Replacing the floor of the employee car park, inserting draining materials that guarantee the partial drainage of rainwater and green areas where to plant tall trees and / or temporarily store rainwater.
Advantages	Increasing the green surface would reduce the thermal inertia of the surfaces, mitigating the effect of prolonged heat waves. The insertion of trees would allow to cover the surfaces covered with a double positive effect on the nearby building (the parking lot is adjacent to the office building which, facing south, would benefit from a better local thermal climate) and on the employees, who would enjoy the shielding of the means during the summer and a more comfortable and aesthetically pleasing environment. The use of green areas as a small reservoir for rainwater would have the advantage of increasing the efficiency of water management within the perimeter of the plant and allowing for a reservoir (albeit limited) in case of surface drainage difficulties.

B.8 Energy management system compliant with ISO 50001

Scope	interior and exterior spaces.
Type of measure	management action.
Description	Implementation of a management system with the aim of monitoring the energy performance of the production process and of the building over time, allowing investments to be planned over time for energy savings, the liveability of internal work environments and the optimization of production processes under the profile of energy consumption.
Advantages	Lower consumption, better working comfort for workers, less injuries.

C. Actions for adaptation to the tornadoes

C.1 Closing tunnel connection in case of strong wind

Scope	shed and outdoor spaces
Type of measure	management action.
Description	Watertight closure of the walls of the covered tunnel and closure of the entrances that the tunnel connects between the two buildings in the event of strong winds.
Advantages	The closure protects the connection tunnel from the wind inlet and avoids "the sail effect". The closure also protects people, materials and machinery from any objects carried by the wind.

C.2 Tree pruning

Scope	shed and outdoor spaces
Type of measure	management action.
Description	Cyclic pruning to prevent the trees from developing very high and extending the foliage forming heavy branches and potentially damaging the adjacent structures in the event of strong winds.
Advantages	Trees pruned frequently (just before the spring season) will form a light crown that can act as a screen for the sun's rays during the summer but at the same time does not represent a danger for the adjacent structures in case of strong wind. Pruning should be repeated cyclically every 3⁄4 years.

C.3 Limited storage of materials outside the building

Scope	shed and outdoor spaces
Type of measure	management action.
Description	Limitation (in time and space) of easily transportable material from the strong wind, fragile or that can create an obstacle to the winds (sail effect).
Advantages	Limiting the storage of material outside the building reduces the risk, in the event of a strong wind or air horn, of lifting material that could injure personnel, damage buildings or vehicles present.

C.4 Shielding surfaces

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Arrangement of shielding surfaces in correspondence of the glass surfaces of the older shed.
Advantages	The screens, in addition to regulating the degree of irradiation, would make it possible to protect, in the event of strong wind, the windows of the buildings (mostly the older one) from breakages that could cause damage to the workers of the plant or damage to machinery and equipment. Their realization must be thought however taking into consideration the wind resistance and the possible sail effect to which the shields can be subjected.

C.5 Roof anchorage

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Additional anchoring of the cantilever roof exposed to strong winds with additional fixing elements.
Advantages	The fixing increases the safety degree of the roof avoiding the opening caused by the "sail effect".

D. Actions to adapt to heavy rains / floods

D.1 Alert systems

Scope	shed and outdoor spaces
Type of measure	infrastructure / management action.
Description	Preparation of a pair of piezometric level sensors that alert in case of regurgitation of the drainage system of rainwater or public sewage.
Advantages	The level sensor, positioned in strategic points of the network, has the task of alerting the plant operator of the criticality in the drainage of rainwater,

	allowing it to implement the first countermeasures (eg closing the non-return valves) for prevent the drainage of the drainage network from affecting office and production premises.

D.2 Anti-reflux valves

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Installation, at nodal points of the rainwater drainage network, of backflow valves or segmentation valves of the rainwater drainage network.
Advantages	The installation of the valves allows to disconnect the outflow network inside the buildings and the drainage of rainwater inside the company perimeter from the characteristics of water runoff in public spaces. The installation of the valves must be conceived in coordination with other infrastructural interventions such as flood-proof bulkheads and warning systems in the event of a drain in the drainage network. The functionality of the valves must be monitored over time to prevent possible obstructions from nullifying their presence.

D.3 Temporary meteoric water storage areas

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Creation of depressed areas within company yards capable of temporarily filling volumes of water that the internal drainage network or sewer system are unable to receive. The interventions can have both an aesthetic and a functional value (rain garden) or represent a volume of reservoir to be used, as needed, as a fire reserve (lamination tank). The most appropriate solution should be weighted according to the available space, the management and maintenance costs to keep the functionality active over time and the business needs.
Advantages	Increasing the volume of water stored within the business area would allow, in the case of intense events that put the stormwater drainage network of the company or the public sewerage network in crisis, to favor underground runoff, increase runoff. and the timing of the corrivation. These temporary storage solutions are designed to collect the meteoric water coming from the washing of the aprons or from the roofs even when the drainage network inside the company has been disconnected from that of the public sewer system or when anti-flooding bulkheads have been installed to protect the entrances access to the company perimeter (driveways to fences). This intervention is not decisive in the event of floods affecting large areas of the territory for which it is not possible to imagine a storage volume that in these cases would be filled quickly and would equally quickly exhaust its rolling function.

D.4 Anti-flooding bulkheads

Scope	shed and outdoor spaces
Type of measure	infrastructural action.
Description	Installation of mobile or fixed anti-flooding bulkheads to protect driveways of the company perimeter or to protect corporate entrances. The best solution can be determined based on the characteristics of the openings, the level of protection chosen and the ease of assembly and use in the event of flooding.
Advantages	The bulkheads avoid, in case of flooding, that the water enters the company perimeter or in the production / storage areas of the goods, limiting almost completely damage to people, things and infrastructure.

D.5 Storage of materials at a safe height from the ground

Scope	shed and outdoor spaces
Type of measure	management action.
Description	It is proposed to store perishable materials or hazardous materials from a chemical-environmental point of view at a sufficiently high altitude that can prevent spillage and / or spills in the event of flooding.
Advantages	Better safety from the environmental point of view of materials and limitation of damage to materials and finished products.