



# Nature-based solution to foster adaptation to climate change

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- AIMEN Technological Center
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# Project overview



Start date: 01/07/2021  
End date: 31/12/2025

Total project budget: 3,038,828 €  
EU financial contribution requested: 1,671,354 €



*Work area: Resilience of infrastructure, including application of blue-green infrastructure and ecosystem-based approaches to adaptation*



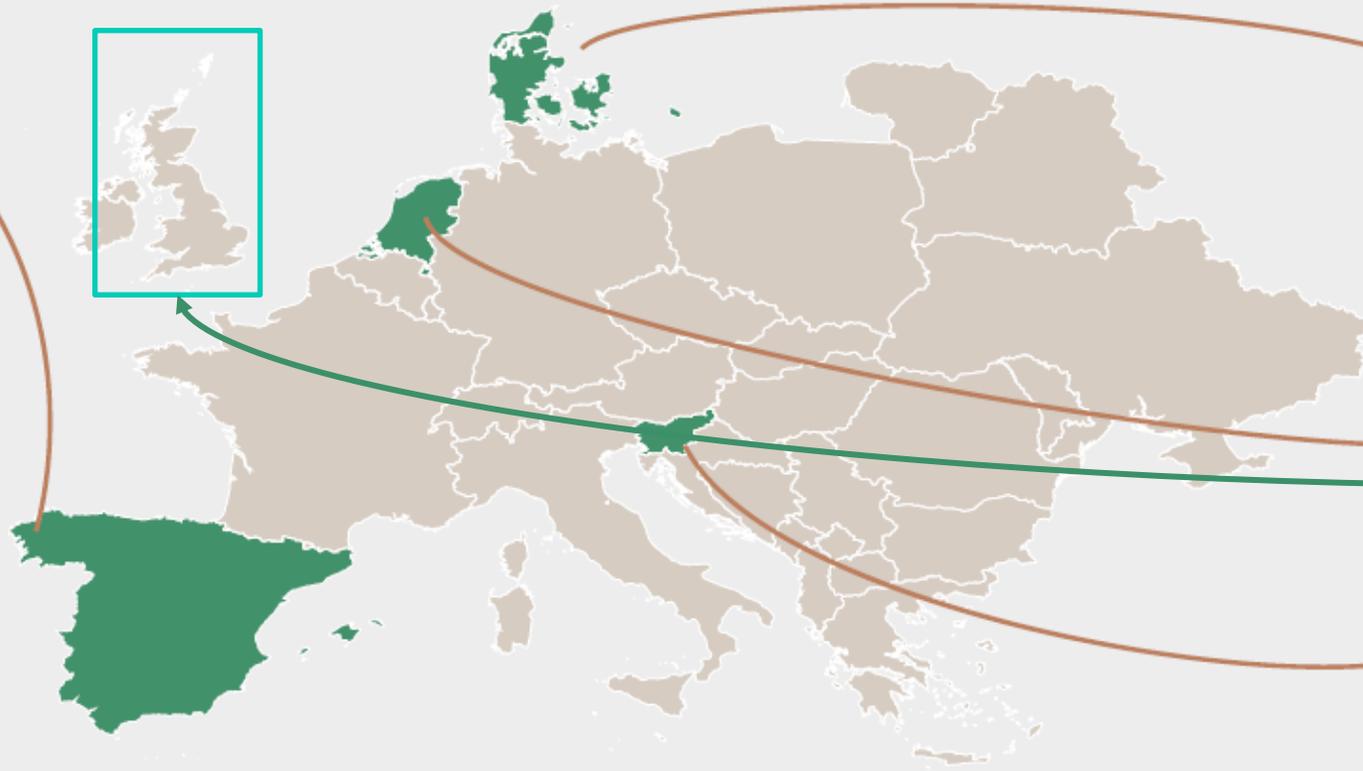
# Consortium



7 partners  
4 countries



Demonstration Site

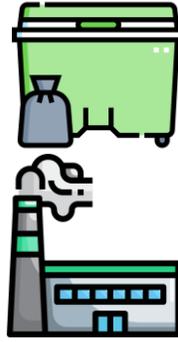




# Project overview – Climate problem

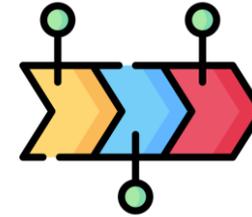


>500.000



80%

20%



140 years

EXTREME WEATHER EVENTS

ADVERSE EFFECTS

DROUGHTS

HEATWAVES



FIRES

HEAVY RAINS



INCREASE OF  
LEACHATES



LANDSLIDES



FLOODS

## **Industrial landfill**

- **Critical infrastructure**
- **Affected by new rain patterns**

## **Blue Green Infrastructures for:**

- **Minimizing risks**
- **and pollution**





# Highly polluted wastewater is generated...

- New rain-water patterns generates:
  - Leachate. Vastly polluted wastewater via percolation.
  - Runoff. Slightly polluted water.
- In absence of treatment, water to:
  - Natural bodies:
  - Rivers.
  - Groundwater reservoirs.



# **Waterproofing the landfill with technosoils**



**Treating lower amount of generated leachate**

# Project overview – Climate problem



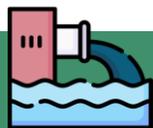
**XILOGA Landfill: Operational since 1999**  
 24,700 m<sup>3</sup> of waste in cell 1 (closed)  
 58,000 m<sup>3</sup> of waste in cell 2 (closed)

## RUN-OFF



Length: 50 m  
 Superior width: 16 m  
 Inferior width: 6 m  
 Depth: 4 m  
 Volume: 2200 m<sup>3</sup>

## LEACHATE

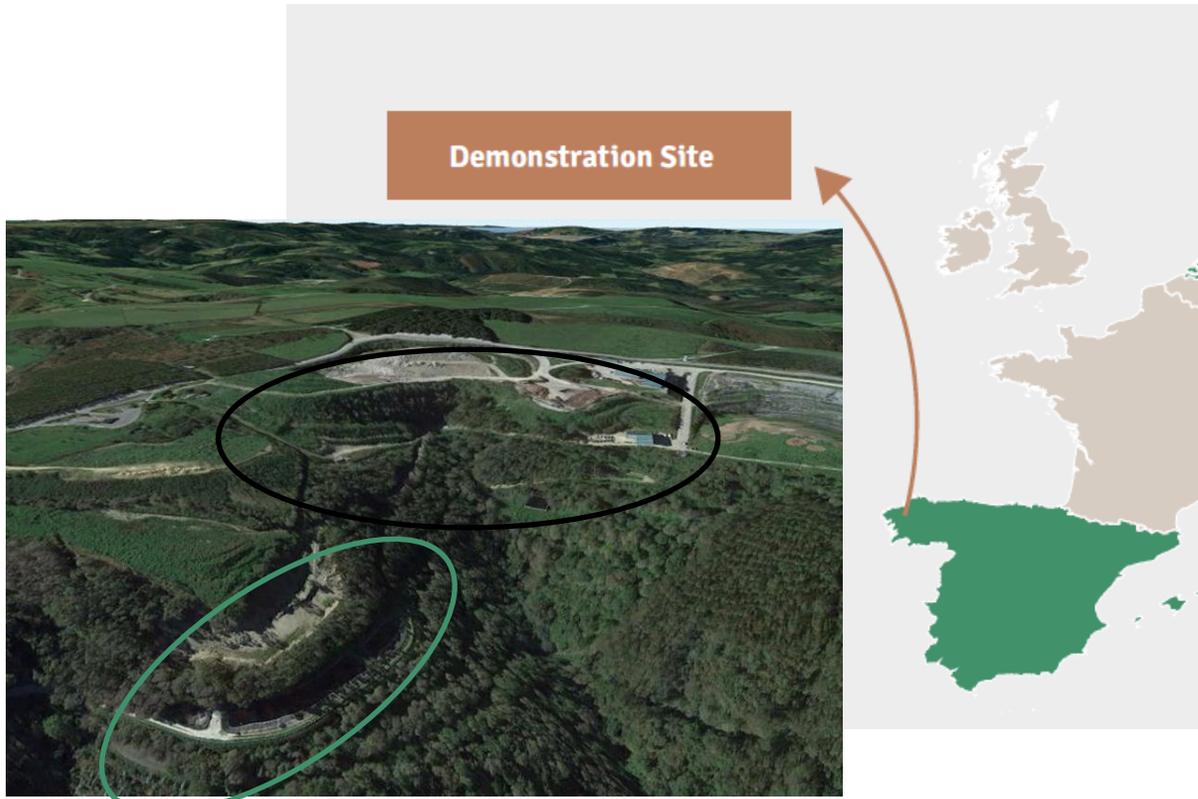


Length: 100 m  
 Superior width: 16 m  
 Inferior width: 6 m  
 Depth: 4 m  
 Volume: 4400 m<sup>3</sup>



Rainfall: 1,000 mm/year

- 37% Dec–Feb
- 34% Sep–Nov
- 27% Mar–May



- Summer: Hot and dry (T 20°C – 30°C)
- Winter: T (10 °C)
- NW winds

# Project overview – Main objective

LIFE GREEN ADAPT aims to *increase the resilience of EU waste infrastructures*

- Focused on landfills
- Impacted by extreme events
- Demonstrating *blue-green infrastructures (BGI) feasibility*

LIFE GREEN ADAPT will demonstrate

- BGI ability to manage *flush flooding and run-off* caused by heavy rainfall
- Also, to *prevent fires and explosions* caused by droughts and unusual heatwaves



© IUCN

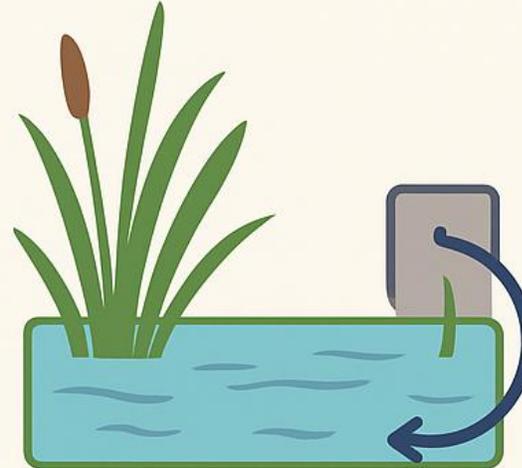
## two different nature-based solutions were developed:

Reducing water percolation through the landfill.



(1)

**TECHNOSOILS TO  
REDUCE THE  
RAINWATER  
PERCOLATING  
THE LANDFILL**



(2)

**NATURE-BASED  
SOLUTIONS FOR  
TREATING THE  
LEACHATE  
WASTEWATER**

Cost-effective treatment of heavily polluted leachate.

# Green infrastructures - Biotechnosoil



## Biotechnosoil:

- Planted with grass
- Increasing biodiversity with endemic plants from the area



# Green infrastructures - Biotechnosoil



## Biotechnosoil:

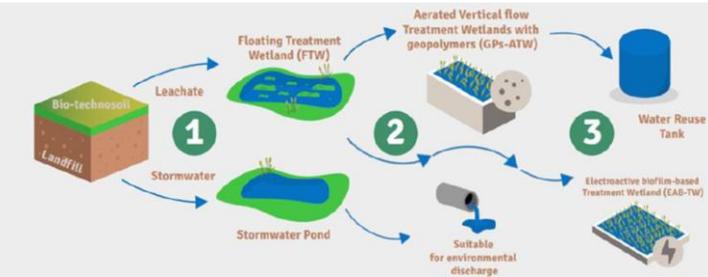
- Mixture of organic and mineral waste (Maturation process)
- Similar properties of a soil
- Waterproofing the landfill.
- Refreshing the temperature within high temperature episodes.

# Blue infrastructures – Wetlands for run-off and landfill leachate

ATW - Planted since May 2023 (*Phragmites Australis*)

FTW – Planted again in May 2024 with *Agrostis Stolonifera* (only vegetable species surviving in leachate)

Electroactive wetlands: Difficulties to find enough quantity of electroactive material in the market



FTW – April 2025

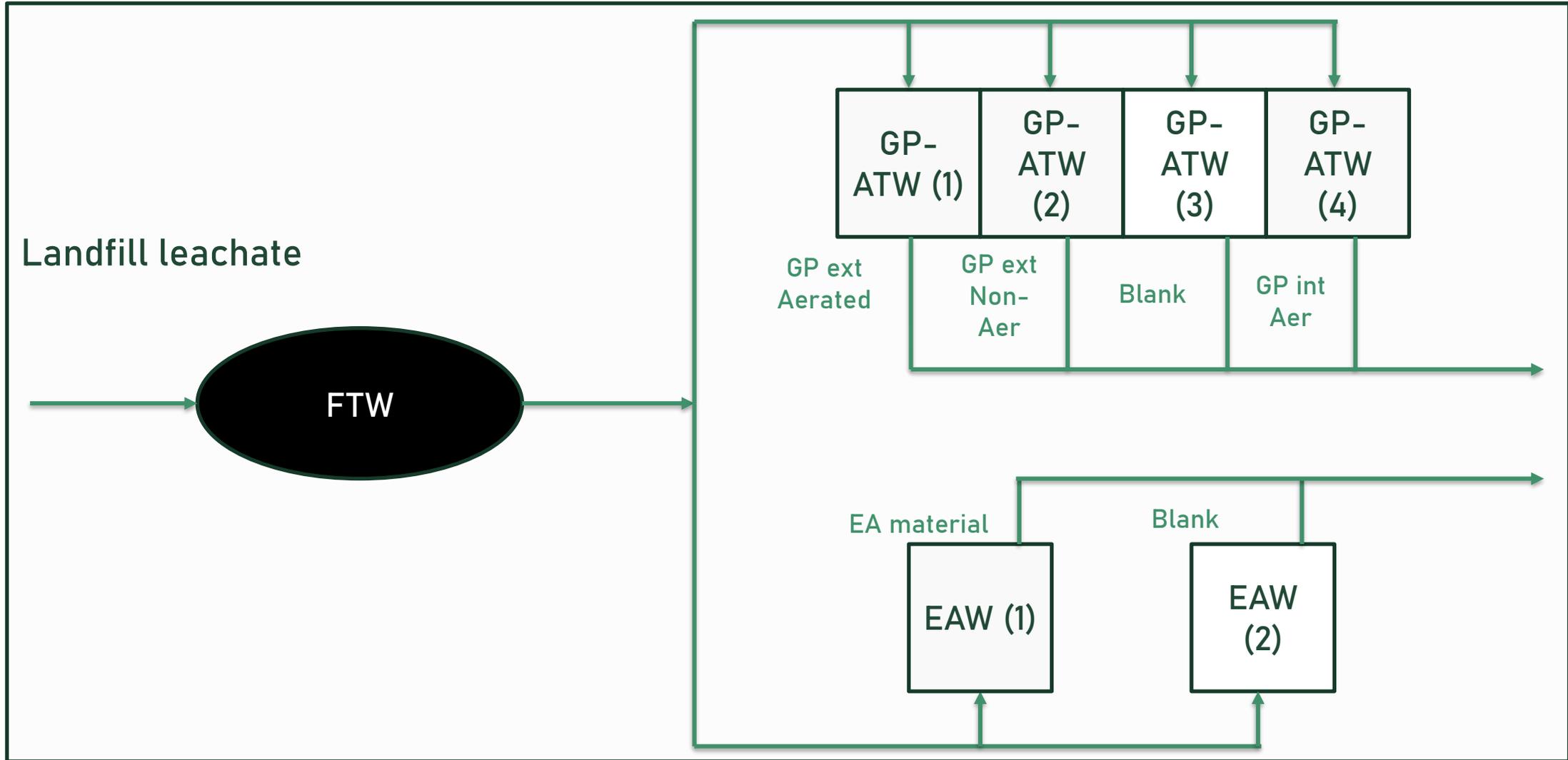


Floating wetlands (FTW) – April 2025



Vertical flow aerated wetlands (ATW) April 2025

# Two steps innovative & cost-effective treatment



# Floating treatment wetland

Main treatment

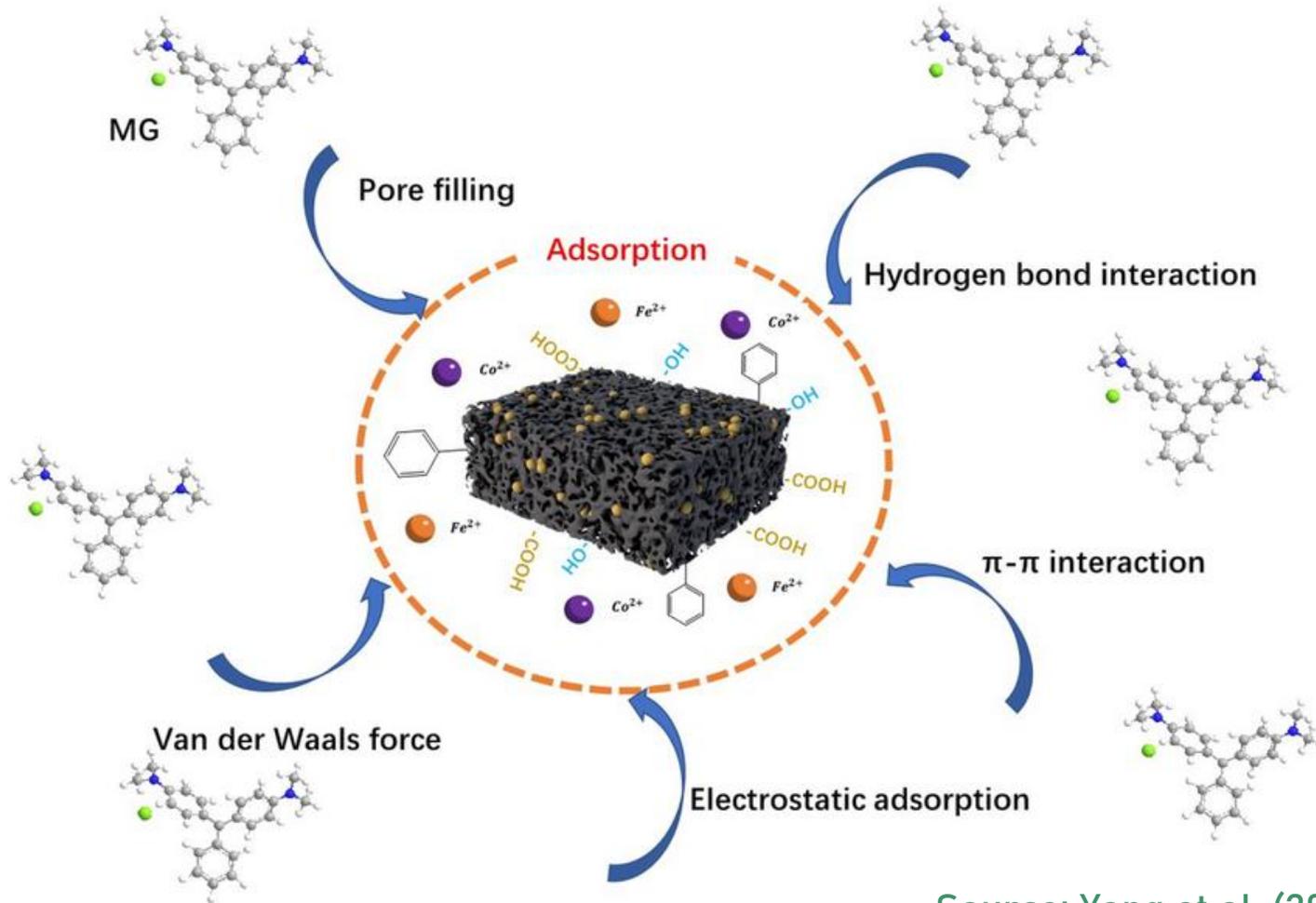
Leachate

FTW

Combined treatment:

Physical  
Biological  
Chemical

# Geopolymers aerated treatment



Source: Yang et al. (2023)

- Organic C
- N, P
- Others



- Porosity
- Electric activation



- Self-developed process

# Key research questions

- $H_2O_2$  : NaOH
- MK : silicate
- Washing



- Curation time
- Temperature
- Sizing of pieces

Vast lab-work

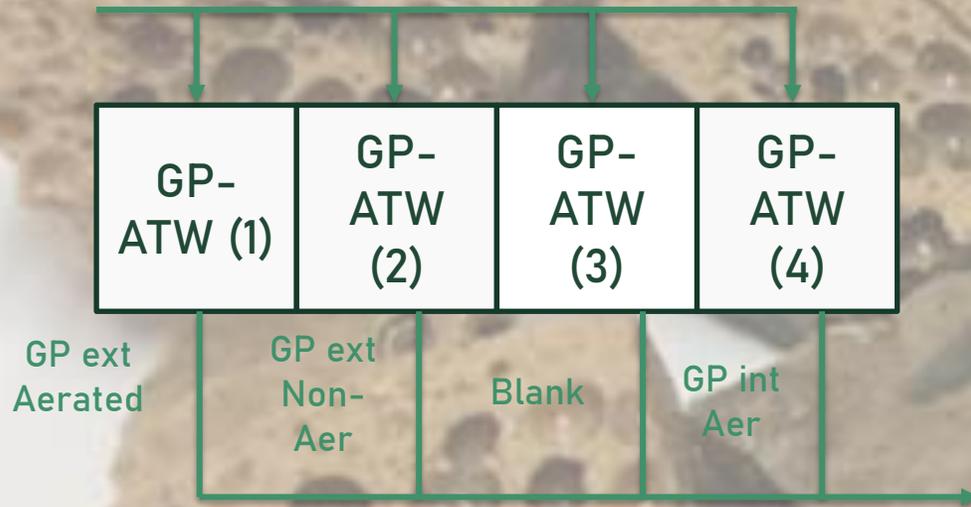


GP - productive process



# Geopolymers aerated treatment

Polishing step



Key research questions:

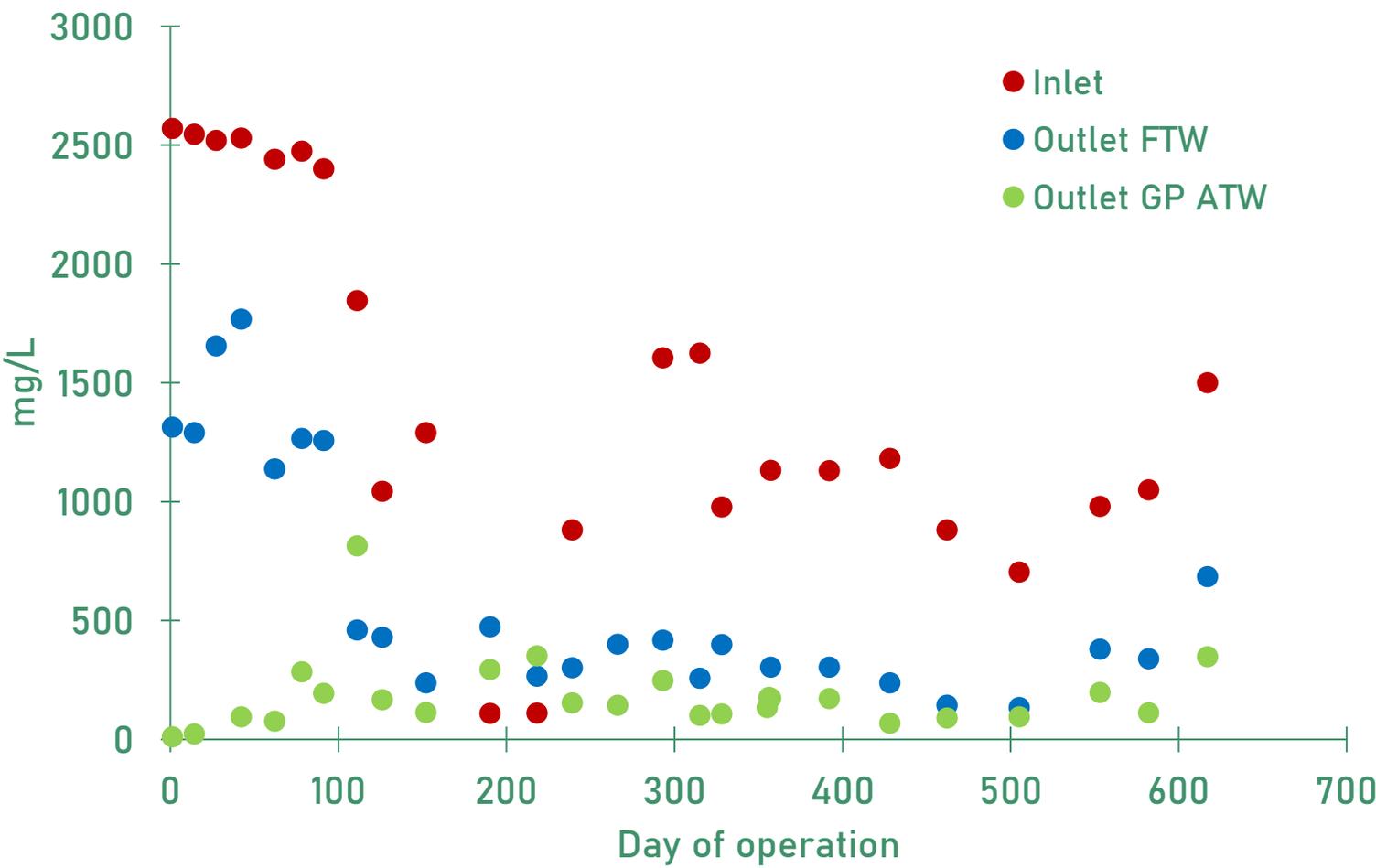
- Aerated / non - aerated?
- Inside / outside the system?



Combined treatment:

- Adsorption
- Electric activation

# Organic carbon removal

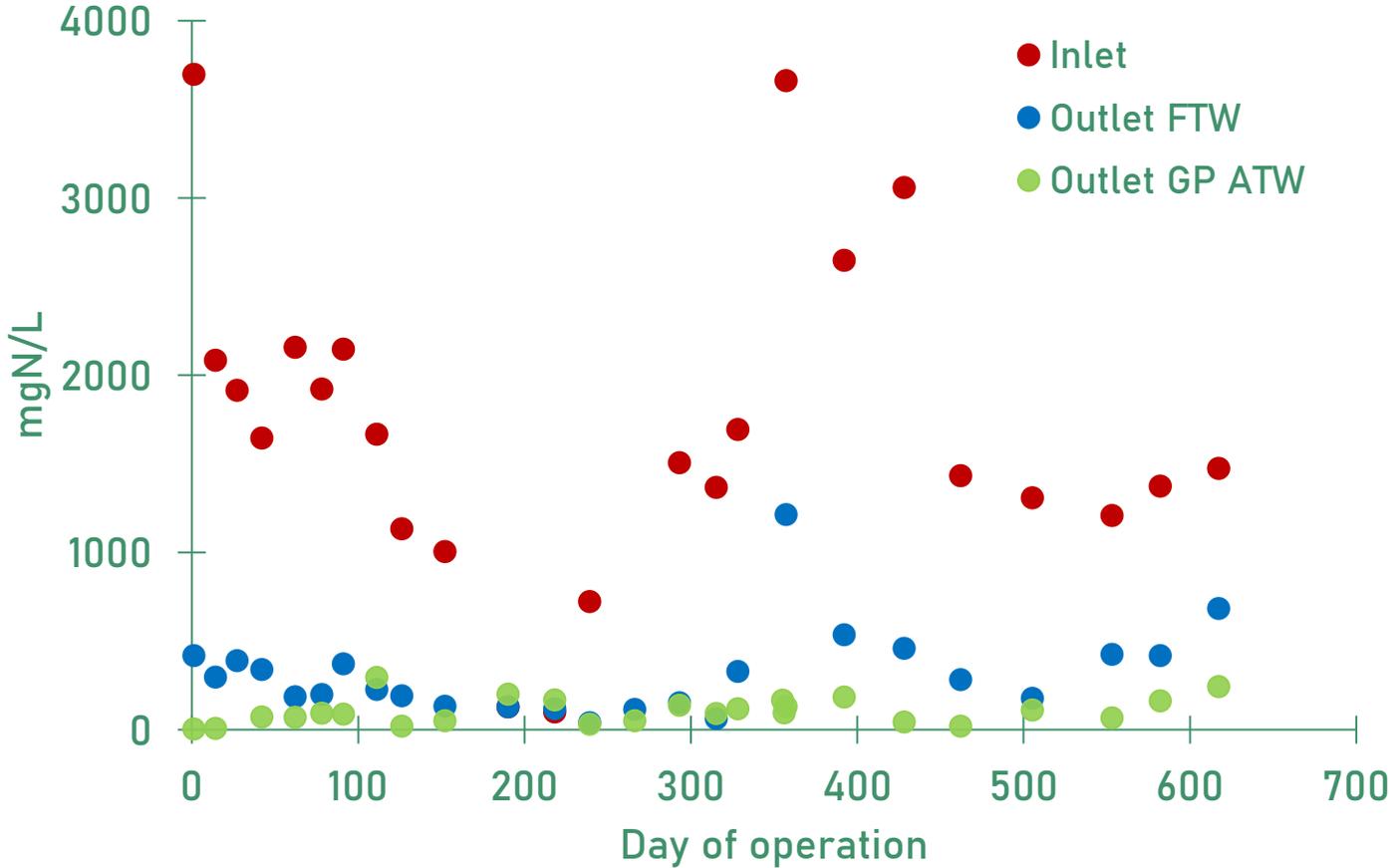


Gradual depletion of the carbon load from the landfill site.

> 80% removal rate attained in FTW + GP ATW

From 1500 down to less than 300 mgCOD/L

# Total nitrogen removal

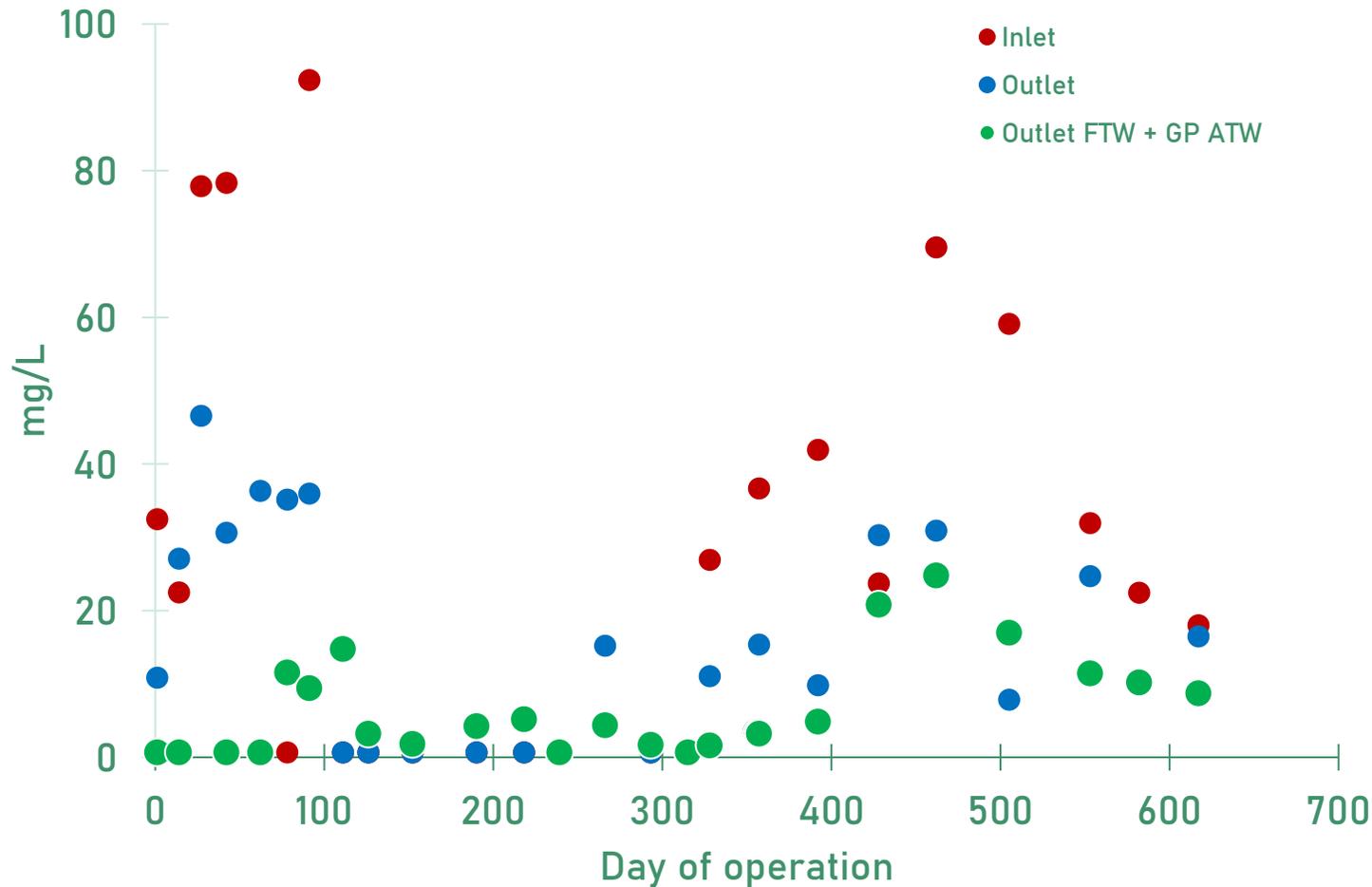


Lower gradual depletion of the pollutant load of the landfill site.

> 80% removal rate attained in FTW + GP ATW

From 1500 down to less than 400 mgTN/L

# Total phosphorus removal

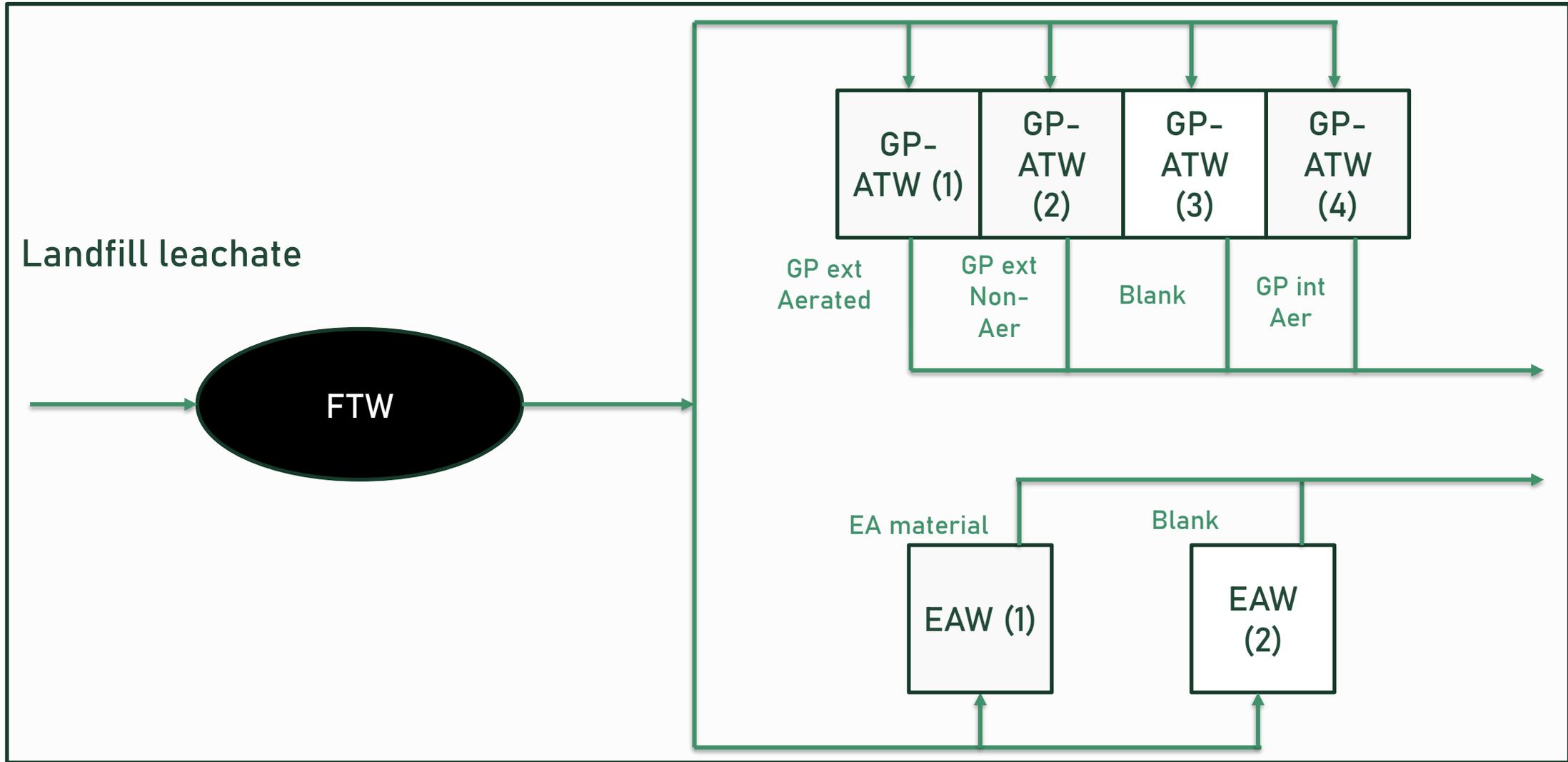


Instable incoming concentration.

> 80% removal rate attained in FTW + GP ATW

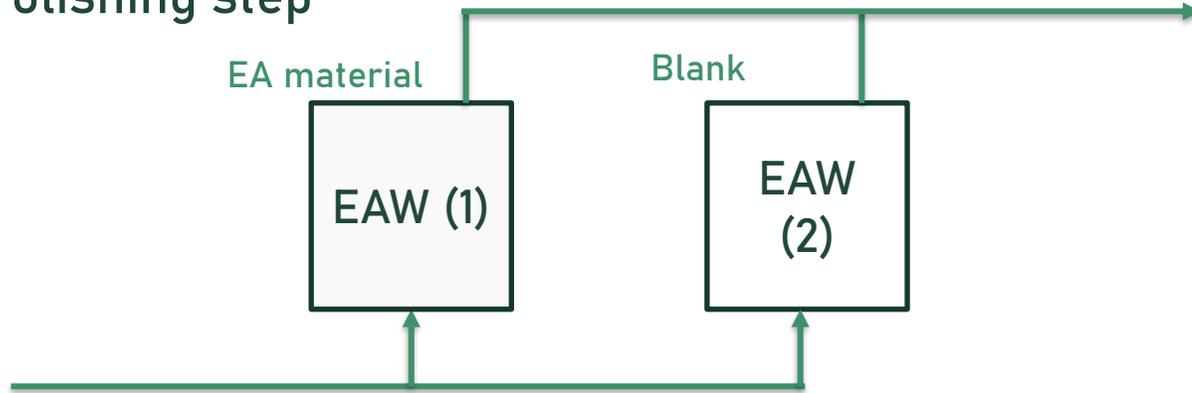
From 40 down to less than 15 mgTP/L

# Two steps innovative & cost-effective treatment



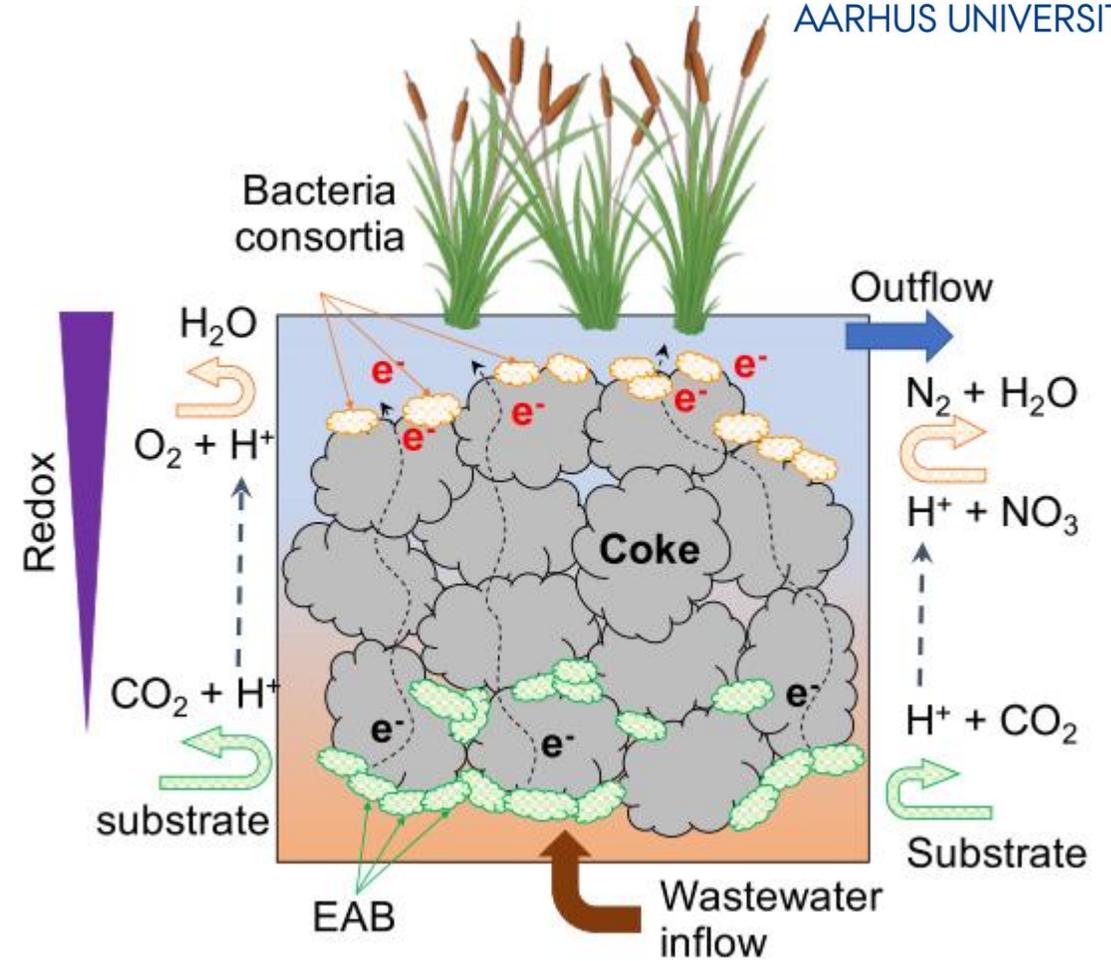
# Electroactive treatment

## Polishing step



## Combined treatment:

- Adsorption
- Electric activation



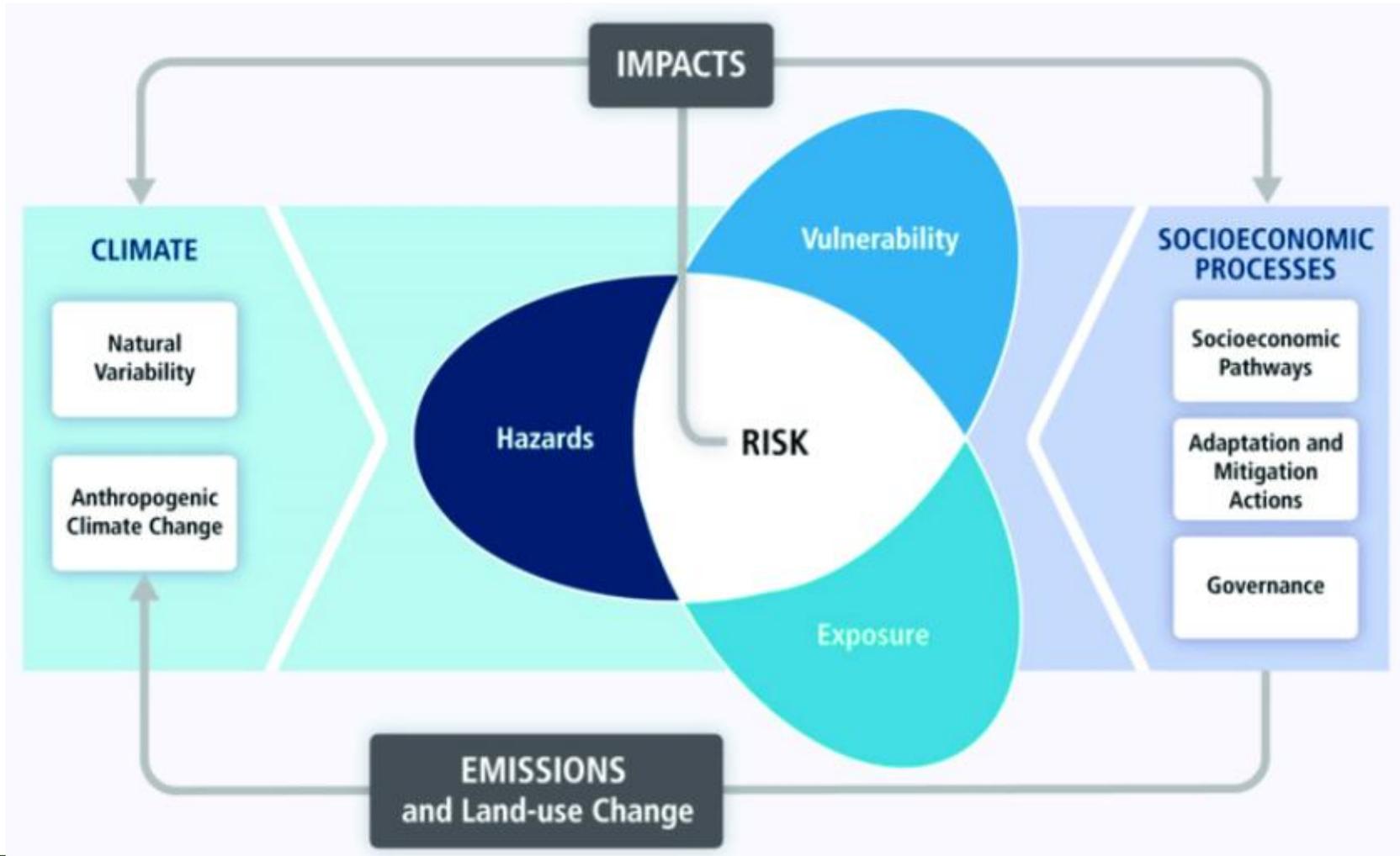
Source: Ramírez-Vargas et al. (2019)

# A holistic approach – final steps

- Finishing experimentation – currently **ongoing**
- Vulnerability risks exposure – already **performed**
- Life cycle, cost and social impact studies - **ongoing**
- IP, exploitation - **ongoing**
- Business models and partnerships – **ongoing**
- Awareness, communication and dissemination - **ongoing**



# Tool for assessing climate-change resilient waste infrastructure



Floods

Wildfires

## Introduction

This tool is a facilitator instrument for carry out an analysis and assessment of risk to specific climate hazards through obtaining risk indices from previously chosen and evaluated indicators and parameters. The tool has been designed to be able to assess two climate hazards (fire and floods) according to the user's needs.

Tool is divided in five main sections:

- The instructions tab provides a brief and concise explanation of how the tool works and is organised to facilitate intuitive navigation.
- Descriptive tabs in which information entered by the user to describe the project is collected and data to be used for the analysis tabs is justified.
- Input tab in which user is expected to fill in the data cells according to previously obtained information with its respective expert criteria.
- Analysis tabs in which user is just able to see the analysed data and verify the process consistency.
- Results tabs showing in order to user's specified ranges, the results before and after the implementation of measures, as well as a comparison between them.

### NOTE

For the correct computation of the tool **ONLY WHITE CELLS** should be modified by the user

Instructions tab  
Descriptive tabs  
Input tab  
Analysis tabs  
Results tabs

## Project Information

In this tab all information related with the object of analysis is expected to be filled in order to identify what is been analysed and understand next tabs information and the results interpretation.



Go to Project information

## Impact Chain

This tab of the tool shows the impact chains associated with the climate-related risks being assessed in the project. The impact chains must be appropriate to the project under study and developed by the user who will include them in this tab of the tool.

Go to Impact chain ->

## Criteria

The tab displays the criteria used by the user and for the user to determine the inputs that the tool is going to use, such as determine the maximum and minimum values that each indicator can take or the ranges that will be used during the analysis and processing of the data.

Indicator type	Indicator	Unit	Description	Criteria		Comment	Source	URL				
				Criteria	Criteria							
S E N S I T I V I T Y	51	Landfill slope	%	Average slope of the area occupied by the landfill facilities.	HIGH 10 LOW 30	A higher slope leads to greater runoff and reduces the risk of water accumulation and flooding in the facilities, if the slope is Low	Google Earth	<a href="https://www.google.com/maps/@41.8888889,8.8888889,15z">https://www.google.com/maps/@41.8888889,8.8888889,15z</a>				
	52	Soil permeability	permeability	Qualitative values of soil permeability based on the present soil type and potential modifications.	HIGH 5 MID HIGH 4 MEDIUM 3 MID LOW 2 LOW 1	Medium - Low Medium Medium - High High	Aimen/Xloga	-				
					53	Distance from facilities to riverbeds	m	Distance in meters to the nearest riverbed from the facility.	HIGH 0 LOW >= 2,000	Based on distance (if distances exceed 2 km, use the maximum limit value of 2 km).	Google Earth	<a href="https://www.google.com/maps/@41.8888889,8.8888889,15z">https://www.google.com/maps/@41.8888889,8.8888889,15z</a>
					54	Nearby pollution sources	m	Distance in meters to nearby points that could be sources of emissions of contaminant waste.	HIGH 0 m LOW >= 2,000	Based on distance (if distances exceed 2 km, use the maximum limit value of 2 km).	Google Earth	<a href="https://www.google.com/maps/@41.8888889,8.8888889,15z">https://www.google.com/maps/@41.8888889,8.8888889,15z</a>
	55	Location of facilities in flood-prone areas	presence / absence	Indicate whether the landfill facilities are located in a flood-prone area.	HIGH 1 LOW 0	Presence in a flood-prone area Presence in a non-flood-prone area	Geoport MITERD	<a href="https://sig.mopoma.gob.es/geoport/2">https://sig.mopoma.gob.es/geoport/2</a>				

THE MAXIMUM AND MINIMUM VALUES THAT EACH INDICATOR CAN HAVE ARE SET ACCORDING TO EXPERT CRITERIA

THE USER SETS OUT THE SOURCE AND URL

THE USER SETS OUT THE CRITERIA APPLIED FOR THAT INDICATOR

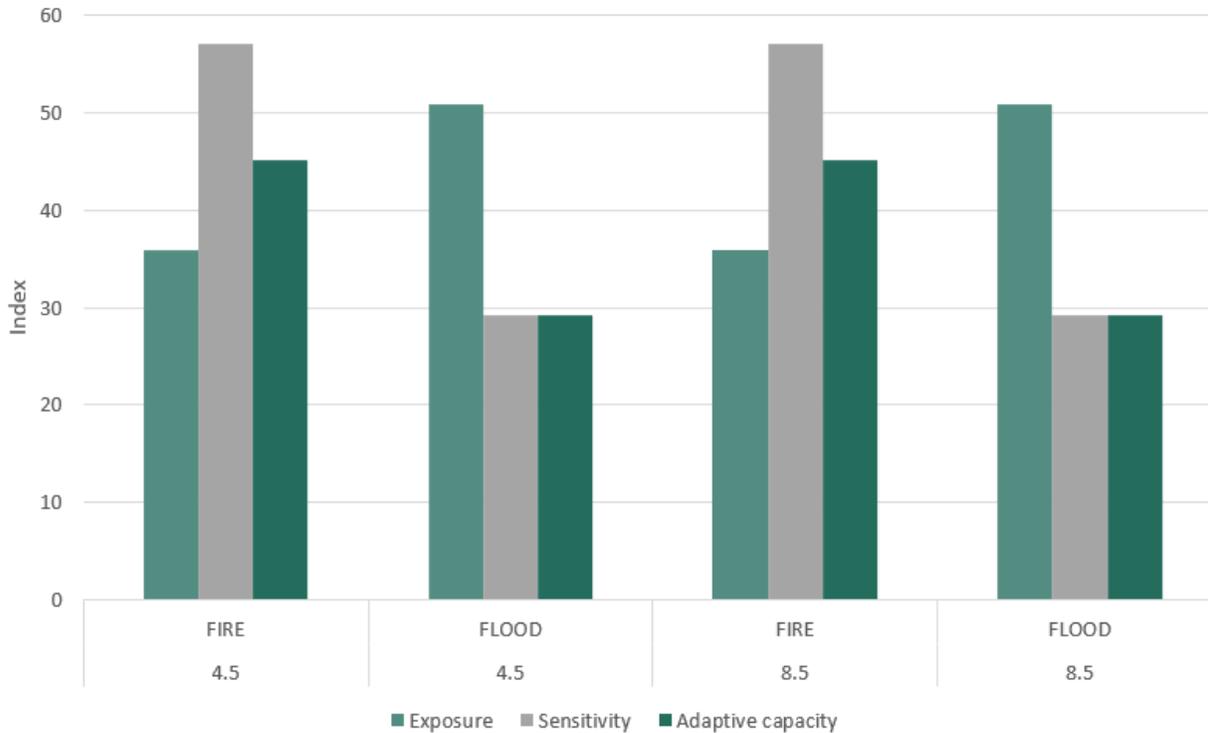
Go to Criteria ->

# Case Study XILOGA

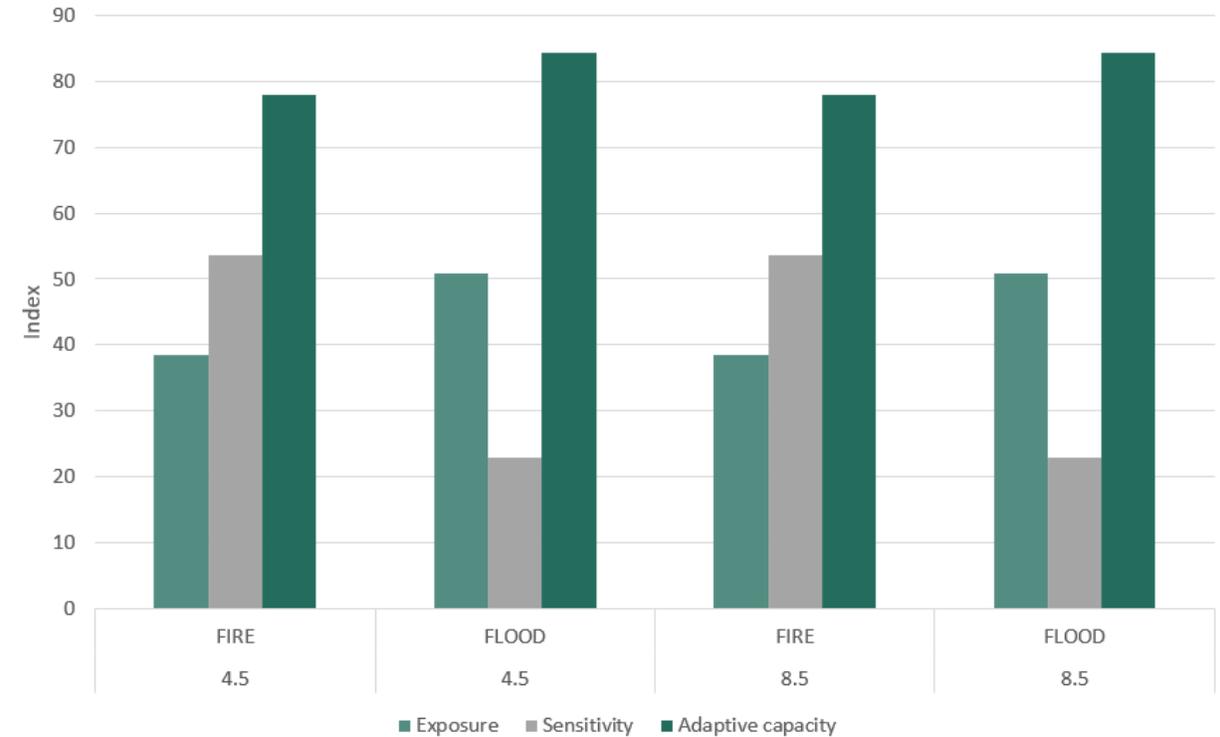
pre - LIFE

post - LIFE

PreLIFE Exposure, sensitivity, and adaptive capacity indices



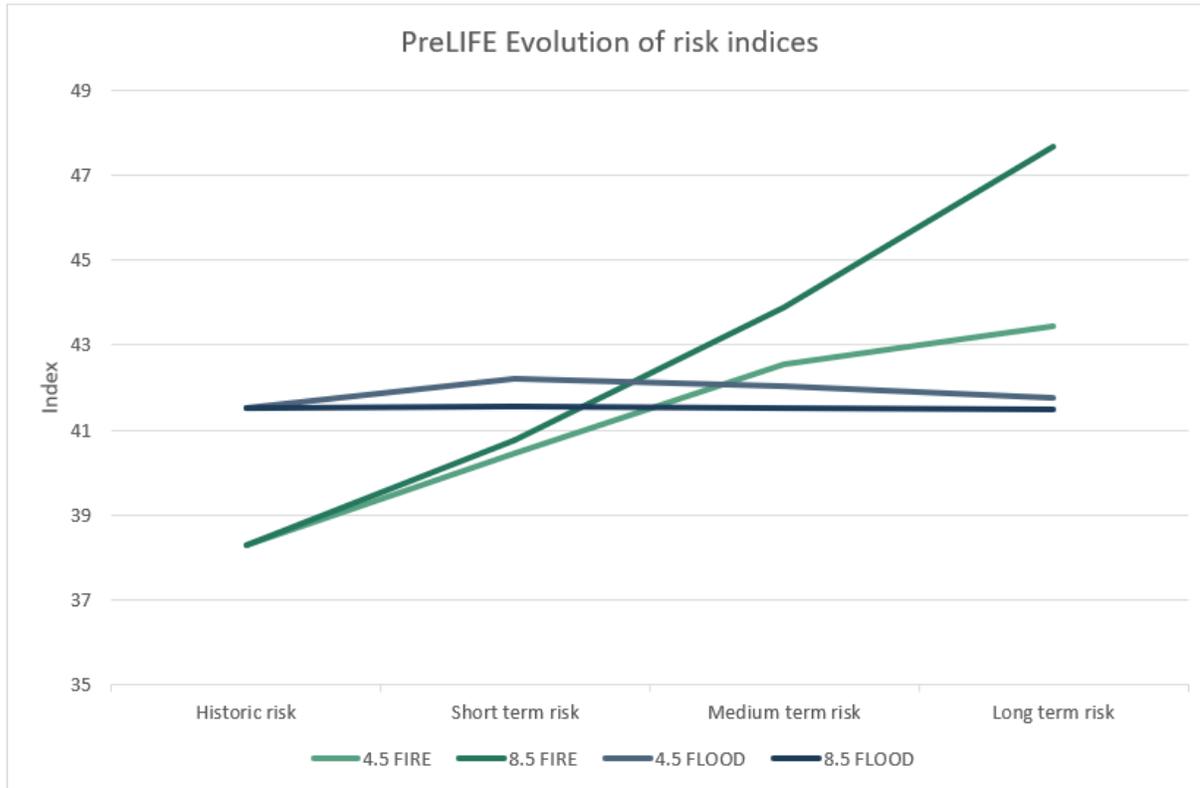
PostLIFE Exposure, sensitivity and adaptive capacity indices



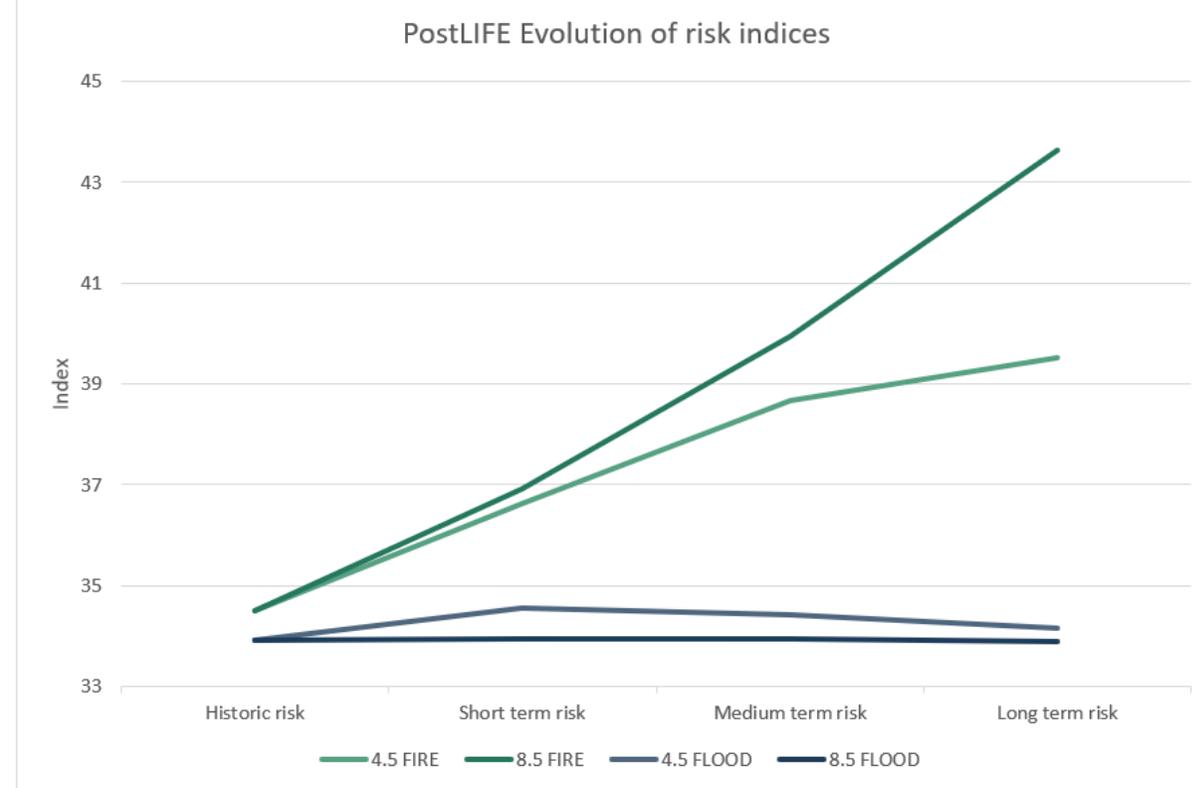
- Increase of adaptative capacity
- Reduction: sensitivity + exposure

# Future projections RCP scenarios

pre - LIFE



post - LIFE



- Flood: great reduction
- Wildfire: less reduction



# Thanks for listening!

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