A Holistic Fire Management Ecosystem for Prevention, Detection and Restoration of Environmental Disasters

TREEADS D.8.1. Report on TREEADS Pan-European Pilot Campaign Plan and Evaluation Methodology

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GLOSSARY OF TERMS

Term	Description
Data Protection Officer	A person ensures that an organization applies the laws protecting individuals' personal data.
Fire behaviour	Change in, or maintenance of, the physical and/or chemical properties of an item and/or structure exposed to fire (ISO 13943:2023).
Fire effluent	All gases and aerosols, including suspended particles, created by combustion or pyrolysis and emitted to the environment (ISO 13943:2023).
Flame front	Boundary of flaming combustion at the surface of a material or propagating through a gaseous mixture (ISO 13943:2023).
Fire propagation	Combination of flame spread and spread of fire effluent (ISO 13943:2023).
Fire-resilient materials	Different materials (e.g., construction materials, coatings, etc.) with improved fire-resistance and/or reaction to fire properties, for passive fire protection of equipment and infrastructure to withstand wildfire conditions; developed, tested and assessed in T4.7.
Flame spread	The propagation of a flame front (ISO 13943:2023).
Informed consent	A founding principle of research ethics, stating that human participants can enter research freely (voluntarily) with full information about what it means for them to take part, and that they give consent before they enter the research (University of Oxford, 2021).

Pilot	A strategy and trial that project managers create to determine how successful a project might be once it's implemented. It can be a smaller version of the project and testing it to give you a better understanding of how well it may perform at full scale.
Pilot phase	The pilots of TREEADS are divided in four time periods, called phases. After each phase, certain milestones will be achieved.

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
AAM	Alkali Activated Slag
AI	Artificial Intelligence
AR	Augmented Reality
CFD	Computational Fluid Dynamics
D	Deliverable to EC as agreed in the Grant Agreement
DMP	Data Management Plan
DPO	Data Protection Officer
EC	European Commission
EO	Earth Observation
FDS	Fire dynamic simulator
GA	Grant Agreement
HAP	High Altitude Platform
HRR	Heat Release Rate
IoT	Internet of Things
IR	Infrared
KPIs	Key Performance Indicators
M	Month of the project

MCC	Mission Control Centre
PCS	Portable Communication System
PFP	Passive fire protection
SCC	Seed Container Capsule
TRL	Technology Readiness Level
T#.#	Task #.#
UAV	Unmanned Aerial Vehicle
VR	Virtual reality
WP	Work Package
WRE	Wildfire Response Engine
WUI	Wildland-Urban Interface

EXECUTIVE SUMMARY

This document defines the pilot campaign plan, including evaluation methodology, for the pilots of the EU funded project TREEADS. The TREEADS project aims to create a holistic Fire Management platform based on several state-of-the-art technologies. Eight pilot campaigns will be conducted in different countries to test and develop the technologies themselves, and to test and improve the integration of the technologies in the TREEADS fire management platform. The pilots will be executed in Norway, Italy, Romania, Spain, Austria, Germany, Greece, and Taiwan, and are part of WP8 in the TREEADS project.

This document describes the pilot campaign plan and evaluation methodology prior to the start of the pilot campaigns. The pilot campaign plan and evaluation methodology contain the following:

- The background and purpose of the pilot, i.e., the pilot stories
- Partners and stakeholders involved, and their roles and responsibilities
- The pilot objectives and KPIs
- Activities in the pilot and how these relate to the objectives and KPIs
- Detailed timeline and inter-dependencies of the planned activities.
- Technologies that will be used in the planned activities
- Plan for data collection and analysis for each activity
- Details on necessary permits and informed consent of participants

The next steps in the evaluation framework are covered by the document “Live document on TREEADS Pan-European and TAIWAN Pilot”. Version 1 of this document is D8.2 and due in M26, while version 2 of this document is D8.3 and due in M40.

INTRODUCTION

ABOUT TREEADS

The aim of the TREEADS project is to unite state-of-the-art high Technology Readiness Level (TRL) products in a holistic fire management platform (the TREEADS platform) that uses and optimizes available Socio-technological Resources in all three main phases of Wildfires: prevention and preparedness, detection and response, and restoration and adaptation. The project is financed under the European Commission (EC) call LC-GD-1-1-2020 and the project consortium consists of 47 partners from Europe and Taiwan.

TREEADS will use a real-time risk evaluation tool that can receive multiple classification inputs and work with a new proposed neural network-powered Risk factor indicator.

To create a model of Fire adapted communities, TREEADS will use alkali activated construction materials integrating post-wildfires wood ashes for fire-resistant buildings and infrastructure. TREEADS also uses a variety of technological solutions such as the Copernicus infrastructure, and several small drones for forest supervision.

TREEADS will use a variety of technologies for fire detection, including wearables for the protective equipment of the emergency responders, and drones and airships for improving capacity in temporal and spatial analysis, and increasing the inspected area.

Last, TREEADS will build a new land and field-based restoration initiative that will use all modern techniques such as agroforestry, drones for seed spread, and Internet of things sensors that will be able to adapt the seeding process based on the ground needs and on the same time with the help of Artificial Intelligence (AI) to determine post-fire risks factors.

TREEADS solutions will be demonstrated and validated under real operating conditions in eight pilot campaigns which are executed in Norway, Germany, Austria, Italy, Spain, Romania, Greece, and Taiwan. The pilot locations have different nature, landscape, climate, and proximity to populated areas. Each pilot will demonstrate some of the technologies that will be integrated in the final version of the TREEADS platform. TREEADS prototypes will be developed for the pilots to test the integration between the technology and the TREEADS platform. To ensure that the integration runs smoothly, an interface protocol will be defined for all processing components and “dummy” components will be interfaced to the general architecture to verify its consistency. All sub-systems will be initially integrated in their own laboratory environments prior to the final integration.

The TREEADS project is planned in five phases: 1) Framework design & Preparation; 2) Technical Development & Innovation; 3) Integration & Validation; 4) Demonstration & Evaluation 5) Horizontal Activities. The start and end month for each phase, and the work packages related to the phases are given in Table 1.

Table 1: Phases of TREEADS

Phase	Duration	Related work packages
1. Framework design & Preparation	M1-M33	WP2
2. Technical Development & Innovation	M1-M41 M7-M33	WP3, WP4, WP5, WP6
3. Integration & Validation	M7-M42	WP7
4. Demonstration & Evaluation	M7-M41	WP8
5. Horizontal Activities	M1-M42 M10-M42	WP1, WP10 WP9

The pilot campaigns are covered by WP8, which is part of the Demonstration & Evaluation phase. This phase runs in parallel with the Integration & Validation phase (i.e., WP7) and the Technical Development & Innovation phase. This allows for stepwise adaption and improvement of technologies and the TREEADS platform based on testing and feedback from the pilot campaigns. The pilot campaigns are divided into four phases of their own, as indicated in Table 2.

Table 2: Phases of the TREEADS pilot campaigns

Pilot phase	Duration
Pilot phase one	M13-M19
Pilot phase two	M20-M26
Pilot phase three	M27-M33
Pilot phase four	M34-M40

ABOUT THIS DELIVERABLE

PURPOSE

This deliverable describes the overall goals and KPIs for the TREEADS pilot campaigns, and gives detailed information about the plans which are made to achieve them, such as experimental procedures, schedule, and attending partners, etc. The TREEADS pilot campaign plans given in this deliverable include the evaluation methodology for the pilots. Some of the pilots will need special permits for their work, such as drone flying permits and burning permits, and this deliverable specifies the status for the necessary applications and permits. The pilot stories have been part of the project since the start but are for the first time presented in a publicly disseminated deliverable here. The evaluation methodology for framework for the TREEADS platform is presented briefly, based on the principles from the Grant Agreement of the TREEADS project.

STRUCTURE AND SCOPE OF THE DELIVERABLE

This deliverable describes the TREEADS pilot campaign plans, including the evaluation methodology for each pilot. The overall goals of the project and plan for evaluation of the TREEADS platform is briefly addressed, but the overall evaluation for the TREEADS project is outside the scope.

This report is split in two main parts. First, a general part that describes the evaluation of the TREEADS platform, what each pilot should include in their pilot campaign plan and evaluation methodology principles that are common for all the pilots. Then, the pilots campaign plans are presented.

This deliverable is completed prior to the start of the pilot campaigns and is therefore describing the pilot plan per M13, and the evaluation methodology to be used. As each pilot progresses, it is expected that plans can change, for example due to changes of staff or delays in supplies. However, this deliverable will not be updated or resubmitted to accommodate these changes.

Although evaluation methodology and plans often contain descriptions of budget, this deliverable will not disclose details about budget as this information is confidential.

RELATION TO OTHER TASKS AND DELIVERABLES

This deliverable is prepared under WP8, Task 8.1. It builds on work conducted in WP2 “Understanding the Lifecycle of Wildfires” and WP3 “Organisational, Structural, and Sociotechnical Factors for TREEADS Ecosystem Building and modular approach”, in which information about the pilot stories and technologies used in TREEADS have been collected. The user stories for the pilots were described in a questionnaire created by WP2 and the needs for the pilots were described in D2.9 “Holistic Management Systems and Resource re-utilisation report V1”. These documents were used as input for this deliverable. TREEADS deliverable D1.8 Data Management Plan, is referenced as it

provides specific details on guidelines for data collection and management which are relevant for the pilots.

The pilots will be continuously evaluated in Task 8.1 and the progress of the pilot campaigns will be documented by milestones MS8, MS9, MS10 and MS11 and by the "Live document on TREEADS Pan-European and TAIWAN Pilot". Two versions of that live document will be submitted as deliverables; D8.2 in M26, and D8.3 in M40.

The evaluation methodology of the TREEADS platform itself is still under development. The principles and plans defined for this in the Grant Agreement are summarized briefly in the next sections.

This deliverable focuses on the pilots, hereunder the campaign plan and evaluation methodology for the pilots. This report is describing KPIs, goals and objectives described for each pilot. The following chapters provide the framework for the evaluation methodology in the pilot campaign plans, and the framework for the pilot campaign plans themselves. The section with framework for the evaluation methodology describes aspects that will be considered in all the pilot campaign plans but may not be explicitly described in the plans at this stage. The framework for the pilot campaign plans is adapted for this particular deliverable and gives a guideline to which information the pilot campaign plans in this deliverable contains.

EVALUATION METHODOLOGY FRAMEWORK

In this chapter, the overall evaluation methodology framework for the TREEADS platform will be briefly presented (this is part of other WPs), and the specific evaluation methodology framework for the pilots will be presented.

TREEADS PLATFORM

OVERALL GOALS AND KPIS

The overall goal of the TREEADS project is to produce a holistic wildfire management platform that contributes to achieving the following requested long term Key Performance Indicators (KPIs) proposed by the European Commission (EC):

- 0 fatalities from wildfires
- 50% reduction in accidental fire ignitions
- 55% reduction in emissions from wildfires
- Control of any extreme and potentially harmful wildfire in less than 24 hours
- 50% of Natura 2000 protected areas to be fire-resilient
- 50% reduction in building losses
- 90% of losses from wildfires insured
- 25% increase in surface area of prescribed fire treatments at EU level

The final platform will combine several technologies that contribute to one or more of these targets. Each technology will collect data or be demonstrated in at least one of the pilot campaigns. These pilot campaigns have their own specific KPIs which relate to the long term KPIs proposed by the EC. These are presented in the pilot campaign plan section.

EVALUATION METHODOLOGY FRAMEWORK FOR THE TREEADS PLATFORM

The TREEADS platform will be integrated and validated stepwise and in parallel with the technical development and innovation of technologies, and the demonstration and evaluation, as shown in Table 1. The integration process will build upon a continuous integration and deployment approach, and a testing and technical evaluation plan will be detailed for the integration.

The evaluation of the TREEADS platform functionality as a system is conducted in WP7, TREEADS Holistic Fire Management System and Incremental approach of all Phases. This work package is active from M7 to M42. WP7 will present an incremental deployment strategy that follows a step-by-step procedure, for enhancing reuse of toolsets in the TREEADS platform. A study of the performance impact of incremental deployment will be carried out to evaluate deployment strategies.

A detailed interoperability plan will be defined to guide the integration of the discrete framework's mechanisms and software components. Following the interoperability plan, the TREEADS consortium will integrate the developed software components to form the final TREEADS platform. Technical testing and evaluation will be based on a method such as STEP (Systematic Test and Evaluation Process).

The stakeholders are identified in the pilot campaigns and will give their input through the pilots they are involved with.

PILOT CAMPAIGNS

The evaluation methodology provides a formal opportunity for the partners to document the steps they will take to conduct the pilots. The evaluation methodology, i.e., what we want to achieve and how we plan to achieve it, is so closely linked to the TREEADS pilot campaign plans that the evaluation methodology is included in the pilot campaign plans in the following sections rather than treated as a separate concept.

The framework for the pilot campaign plans focuses on what is unique for each pilot. All the pilots in TREEADS work closely with stakeholders who provide information for both the pilot campaigns and other work packages, such as WP2 Understanding the Lifecycle of Wildfires, and WP3 Organisational, Structural, and Sociotechnical Factors for TREEADS Ecosystem Building and modular approach. To maintain a good relationship with the stakeholders, the stakeholders can be invited to bring up wildfire-related topics in pilot activities such as workshops, regardless of whether the topic they bring up is in focus in that particular pilot. Therefore, all pilots may to some extent be involved in all three phases of wildfires (prevention and preparedness, detection and response, and restoration and adaptation). However, when it comes to the demonstration of TREEADS technologies, and hence the pilot campaign plans given here, the pilots may have one or two wildfire phases in focus rather than all three.

FRAMEWORK FOR THE PILOT CAMPAIGN PLANS

The pilot campaign plans given in this deliverable are both specific plans stating which activities are planned and when they will happen, and descriptions of the methods used for evaluation of the achievement of KPIs, objectives and goals.

Glenaffric (2007) defined six steps which form the basis for the design and implementation of evaluation activities. This handbook is mainly applicable for development activities in the innovative use of information and communications technology to support education and research, but the principles can still offer guidance to the TREEADS project. The six steps are to (1) Identify Stakeholders, (2) Describe project and understand programme, (3) Design evaluation, (4) Gather evidence, (5) Analyse results and (6) Report findings. These steps have been used as a basis for the approach which will be used in the TREEADS pilots. In addition, documents describing evaluation methodologies for six other EU projects have been studied.

The following items have been determined as the basis for the TREEADS pilot campaign plans. When these nine items have been described, the pilot evaluation methodology is inherently also described.

- Describe the background and purpose of the pilot, i.e., the pilot stories
- Identify partners and stakeholders and their roles and responsibilities
- Describe the pilot objectives and KPIs
- Describe which activities the pilot will consist of and how these relate to the objectives and KPIs
- Make a detailed timeline and describe inter-dependencies of the planned activities
- Describe which technologies will be used in the planned activities
- Describe a plan for data collection and analysis for each activity
- Give details of other features of the pilot that are important for permits and informed consent.

PILOT CAMPAIGN PLANS

In this chapter, the pilot campaign plan for each pilot will be presented. A visual abstract for each pilot is presented along with the background and purpose of the pilot.

NORWEGIAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

Several unique types of landscapes exist in Norway, ranging from coastal regions with mainly grass, heather and shrub vegetation, deep forested areas of old pine, and highland and mountain with sparse vegetation due to the relatively low tree line. Subsequently, the ecosystems vary depending on the landscape with mixed forests, coastal conifer forests, some Nordic taiga, tundra and montane birch forests and grasslands. These varieties also affect how the wildfires in Norway behave. For example, fjords and stony mountainous ranges can act as natural barriers for the fires.

The Norwegian pilot campaign will focus on forested, inland areas in the eastern part of Norway and on coastal landscapes with heather, grass, and scrub vegetation in western part of Norway. The coastal areas border the North Atlantic Sea and experience a relatively mild climate with a lot of rain whereas the inner part is in a “rain shadow” experiencing less mild climate. These inland areas are more prone to heatwaves and cold fronts arriving from the Russian continental areas. The inland forest areas in eastern part of Norway have many similarities with the neighbouring Swedish forests.

Another special feature of Norway is that there are populated areas and infrastructure scattered along the entire long length of the country, giving a massive extension of the wildland-urban interface (WUI) areas. In these WUI areas, there is key infrastructure of steel and concrete, such as power gridlines and other related infrastructure that could be exposed to wildfires. Also located in the WUI areas are buildings and

cottages built for residential and recreational purposes. Historically, wood has been a key construction material, and still is today; Norwegians build the majority of their residential homes and cottages in wood. There are therefore many wooden structures located in WUI areas. Protection of wooden structure and key infrastructure in steel and concrete, is therefore an important aspect of wildfires resilience in Norway.

During field work, the fire brigade has a need for an overview of logistical data such as status and whereabouts of products- for instance equipment, parts, water reserves, fuel, and so forth. A dedicated system for product breakdown using open standards such as ISO 10303, providing the user with information retaining to the status of all relevant parts of a product and relevant sensor data would be beneficial. Today, the fire brigades have systems for logistics, however, they are not standardized and are applied differently between locations.

Recently, extreme conditions such as droughts and massive rain resulting in floods have become more frequent in Norway. The extent and frequency of wildland fires in Norway is expected to increase in the coming decades, due to climate changes. Today, wildfires are most frequent during summer months, but special cases of large winter wildfires have also been observed recently (e.g., the Flatanger, Frøya and Lærdal fires of January 2014). The occurrence of wildfires at unexpected times of year is expected to become more common. Having a proactive approach and including building- and infrastructure fire resilience in the overall approach now will help Norway be more resilient to wildfires in the coming time.

The field work in the Norwegian pilot of TREEADS is conducted in collaboration with fire services in coastal areas (Bergen coastal-region and Frøya) and inland areas (Bergen forest-region and Skien), among others. The exact locations and dates for field work are decided by the fire services that need to be present and depends both on the weather conditions and their availability. The planned locations for field work are shown in Figure 1.

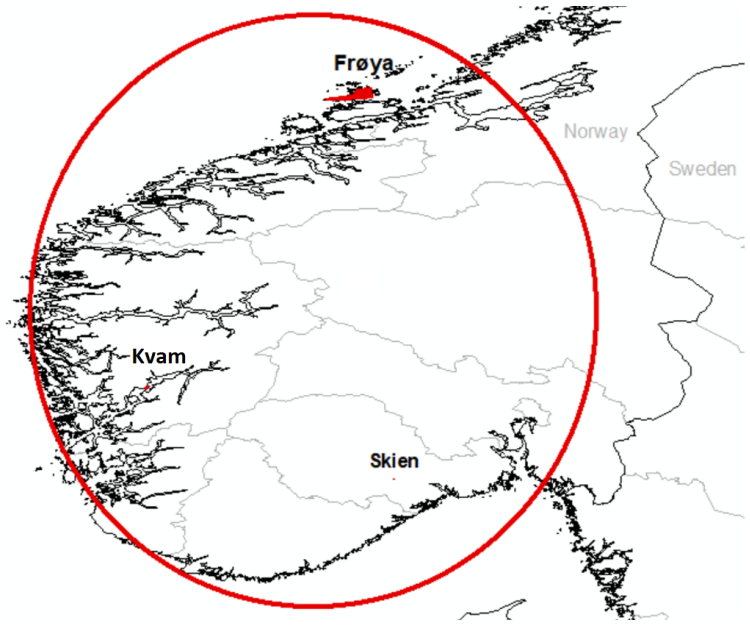


Figure 1: Locations for field work in the Norwegian pilot, marked in red. The locations for the exercises may be changed slightly depending on where the local fire authorities decide to have their exercises. Frøya is an island and most of the island is marked in the map. The location Kvam is near Bergen, and the exercise in that area is coordinated with fire authorities in Kvam, Bergen and other local fire brigades. For Skien, the town of Skien is marked, but the forest areas near the town is the location of the exercise.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the Norwegian pilot campaign and the TREEADS consortium are given in Table 3. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 4.

Table 3: TREEADS partners and their roles in the Norwegian pilot campaign.

Partner	Role	Short description of responsibilities
FRN	Pilot leader	FRN is the leader of the task. FRN will be responsible for planning, organizing, and executing the field and laboratory experiments.
VIPO	Pilot partner	Provide and develop passive fire protection (PFP) products for key steel and concrete infrastructure
WAS	Pilot partner	Provide and develop PFP products for wooden buildings and infrastructure
Jotne	Pilot partner	Interoperability Solution, gather data during field exercises, use data from laboratory experiments, create standardised data solutions for improved rescue logistics.

CBS	Associated pilot partner	Cost-effective suggestions and guidelines based on the pilots' contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
DTU	Associated pilot partner	If applicable, economic assessments of impacts, preventive actions, and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested
8BELLS	Associated pilot partner	Provide AR-helmets and perform measurements related to the use of these with fire fighters in field exercises. Involvement and details are pending final discussions.
LAMMC	Associated pilot partner	Collect Norwegian soil and seed samples for use in other parts of TREEADS. Possibly provide soil sampling tools for Norwegian partners to collect. Involvement and details are pending final discussions.
OS	Associated pilot partner	Provide extinguishing foam solutions for infrastructure protection, either for field exercises or laboratory experiments. Involvement and details are pending final discussions.

Table 4: External participants/ key stakeholders involved in the Norwegian pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
The Norwegian Directorate for Civil Protection	Letter of intent provided, input to guidelines and other activities.	E, M, W
Statskog	Letter of intent provided, input to guidelines.	E, W
Skien fire and rescue service	Letter of intent provided, field experiments with forest fires, input to guidelines.	E, M, W, S, F
Frøya fire and rescue service	Pending collaboration agreement, field experiments with heatherland fires, input to guidelines.	E, M, W, S, F

Bergen fire and rescue service	Pending collaboration agreement, field experiments with heatherland fires, input to guidelines.	E, M, W, S, F
Misc. stakeholders	As indicated in survey and at stakeholder workshop 9th November 2022.	

PILOT OBJECTIVES AND KPIS

The main activities of the Norwegian pilot campaign are related to prevention and preparedness, and detection and response. These are the objectives:

- Characterize wildland fire in Norwegian forest and coastal heather land by field measurements of flame propagation speed, temperature, and heat flux.
- Develop a realistic test method and perform controlled tests to evaluate the performance of passive fire protection products for wooden buildings and key steel and concrete infrastructure exposed to wildland fires.
- Provide suggestions and guidelines regarding necessary safety zones around critical infrastructure and WUI areas based on Norwegian conditions.
- Provide suggestions and guidelines regarding building technical requirements and detailing for wooden houses and cottages in areas with high risk of wildland fires.
- Develop cost-effective methods to protect key infrastructures and residential building in areas with a high risk of wildland fires.
- Streamline rescue and logistics processes by standardizing data from the IoT (sensors etc.) used in the pilot, using relevant ISO standards.

In the Norwegian pilot, the following long term KPIs as proposed by the EC are targeted:

- Control of any extreme and potentially harmful wildfire in less than 24 hours
- 50% reduction in building losses and infrastructure

In addition, the specific KPIs have been identified by the following TREEADS partners:

- VIPO: 20% Reduction of weight for protection product, 30% Reduction in cost of protection product.
- Jotne: 30% improvement in data exchange, sharing and archiving, 20% improvement in interoperability logistics (improved rescue logistics for the fire brigade), 20% improvement in asset information system (for partners connected to the UC).

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In "Annex 1: Norwegian pilot task 8.2", a detailed overview of activities and schedule for the pilot is provided. Here an overview is given.

- Activities (NO-01/02/13/14/17/26) are related to objective on "characterizing wildland fires in Norwegian forest and coastal heather land" and targeting EUs KPI on 24h wildfire control.
- Activities (NO-03/09/14/15/22/25/27) are related to objective on "developing a realistic test method and to perform controlled tests to evaluate the performance of passive fire protection products" and targeting Eus KPI on 50% reduction in building losses and infrastructure.
- Activities (NO-04/14/16/18/20/22/23/24/28/29/30) are related to objective on "providing suggestions and guidelines regarding necessary safety zones around critical infrastructure in WUI areas based on Norwegian conditions" and targeting Eus KPI on 50% reduction in building losses and infrastructure.
- Activities (NO-04/14/18/22/23/24/28/29/31) are related to objective on "providing suggestions and guidelines regarding building technical requirements and detailing for wooden houses and cottages in areas with high risk of wildland fires" and targeting Eus KPI on 50% reduction in building losses and infrastructure.
- Activities (NO-05/06/07/08/10/11/14/15/20/23/24/25/28/29) are related to objective on "developing cost-effective methods to protect key infrastructures and residential building in areas with a high risk of wildland fires" and targeting Eus KPI on 50% reduction in building losses and infrastructure.
- Activities (NO-12/13/16/17/19/21/32) are related to objective on "streamline rescue and logistics processes" and targeting Eus KPI on 24h wildfire control.
- Activities (NO-13/14/17/26) are related to objective on "characterizing wildland fires in Norwegian forest and coastal heather land" and targeting Eus KPI on 24h wildfire control.

The pilot leader will arrange regular meetings with pilot partners (minimum bi-monthly), associated pilot partners (minimum quarterly) and key stakeholders (minimum every 6 months) to discuss progress. Workshops involving several partners and stakeholders will be arranged when necessary for the progress of the activity (minimum yearly). A stakeholder workshop will be arranged in M12.

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Norwegian pilot campaign is given in Table 5. A more detailed timeline is presented in Annex 1. Table 6 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 5: Overall timeline for the Norwegian pilot campaign.

Schedule	Description of activities planned
M13-M19	*Table-top exercises & preparations*: this activity includes planning of all activities in the pilot: Coordination/table-top exercises with fire brigades and other involved stakeholders related to the field exercises in *Execution part 1*. Survey and evaluation of relevance of test methods for *Execution part 2*. Survey of relevant background information and relevant guidelines for activity *Post-processing*. Survey of key information related to wildfires in Norway, as input to *Execution part 2* and *Post-processing*. Initial TREEADS cloud-based database server for partners to populate assets, including sensors, and software.
M13-M38	*Execution part 1*: Field exercises in Norwegian forest and costal land, performed during Norwegian spring seasons. Measurements of flame propagation speed, temperature, heat flux. Streamlining of logistical processes related to firefighting efforts of wildfires. Integrating the measurements and logistics into the TREEADS platform. Integrating the field measurements into the test methods in *Execution part 2.* Integration of relevant findings in the field exercises into the guidelines work in *Post-processing.* Use of the TREEADS server in field exercises.
M18-M38	*Execution part 2:* Development of realistic test methods relevant for wildland fires (based on input from *Table-top exercises & preparations* and from *Execution part 1*), and execution of experiments to document and evaluate the reaction to fire properties and performance of the PFP technologies for protection of steel, concrete and wood infrastructure exposed to wildland fires. Integrating the results into the TREEADS platform. Output from this activity will give input to the guideline development in *Post-processing*. Consider to use the TREEADS server in the experiments.

M26-M40	*Post-processing:* Summarize the findings related to the development of cost-effective methods to protect infrastructure and buildings in areas with a high risk of wildland fires. Provide suggestions and guidelines for safety zones and WUI areas based on Norwegian conditions. Provide suggestions and guidelines for building technical requirements for wooden buildings in areas with a high risk of wildland fires. Finalize the work on streamlining rescue and logistics processes. In this activity, input will be taken from *Table-top exercises & preparations,* from *Execution part 1* and from *Execution part 2.* Create roadmap for improvements of the TREEADS server

Table 6: Activities with dependency on other activities in the Norwegian pilot campaign.

Activities	Dependency
Activity NO-06/10/23/28 depends on Activity in WP4	The development of the PFP technologies is a part of WP4 task 4-7. The results from this will give input to activity *Execution part 1* and activity *Post-processing*. Delays in WP4 (development of the PFP technologies) can thus cause pilot delays.
Activity NO-22/29/31 depends on Activity NO-15	The field work in activity *Execution part 1* will give input to the test development in *Execution part 2* and to the guideline development in activity *Post-processing*. This will be an iterative process during the whole activity period for *Execution part 1*. The first field exercises will be most important for test development (*Execution part 2*), and all field exercises will be important for guidelines *(Post-processing)*. Delays in one activity will cause delays in the others.
Activity specified in Table 5.	In addition to the dependency described above, within the four main activity groups within the pilot, there are a number of interdependencies, see Table 5 for details. Delays related to one activity may cause delays in others.
Activity NO-13/17/19/26/27/ depends on Activity in WP7	The development of a database created from the inventory list is a part of WP7 task 7.1 and 7.3. The results from this will give input to activity *Table-top exercises & preparations.* Delays in WP7 (development of the database) can thus cause pilot delays.

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Information to be monitored before, during and after fire:

- Heat flux
- Flame spread
- Temperatures
- Flame penetration in material
- Possibly soil samples, to be agreed upon
- Possibly measurement of Normalised difference vegetation index (pending)

Technologies used in the pilot:

- Fire retardant treated wooden materials for buildings
- Passive fire protection for steel and concrete infrastructure
- ISO 10303 Product Lifecycle Management repository
- Augmented Reality (AR)-helmet technology for fire fighters, (pending)
- Extinguishing foam for building application, (pending)

Table 7: TREEADS technologies used in the Norwegian pilot campaign.

Technology	Responsible partner, Partners involved	Technology will be used in this main activity
Measurement equipment	FRN, RISE	Execution part 1: Field exercises in Norwegian forest and costal land. Execution part 2 (medium/large scale experiments).
Passive fire protection coating for steel and concrete infrastructure	VIPO, FRN	Table-top exercises & preparations (part of WP4 task 4.7) Execution part 2 (medium/large scale experiments)
Fire retardant treated wooden materials for buildings	WAS, FRN	Table-top exercises & preparations (part of WP4 task 4.7) Execution part 2 (medium/large scale experiments)
TREEADS server	Jotne	Data management system for TREEADS field exercises and experiments based on the open standard ISO 10303

AR-helmet technology for fire fighters	8BELLS	Execution part 1: Field exercises in Norwegian forest and costal land.
Extinguishing foam for building application	OS	Execution part 2 (medium/large scale experiments)

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 8: Plan for data collection and analysis in the Norwegian pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Soil data (pending)	Field work	LAMMC	N/A	Activity NO-14
Temperature, heat flux, flame spread, fuel data, weather data	Field work, national databases	FRN	N/A	Activity NO-14
Reaction to fire properties, incl. temperature	Laboratory experiments	FRN	N/A	Activity NO-25
Logistics data	Fire brigade	Jotne	ISO 10303	Activity NO-12
Asset data	Asset provider/partner	Jotne	ISO 10303	Activity NO-13

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Table 9: Information on permits required and plan for obtaining these in the Norwegian pilot campaign.

Permit	Status/ plan
Permit for burning of forests in the Skien district	Necessary permits already granted, as part of fire brigades training work.
Permit for burning of heatherland in the Bergen district	If field work will be performed here, the necessary permits are already granted, as part of fire brigades training work.
Permit for burning of heatherland in the Frøya district	If field work will be performed here, the necessary permits are already granted, as part of fire brigades training work.
Storage of personal information/ other sensitive data	If storage of personal information or other sensitive data will be used, consent must be given, and it must be considered whether necessary to apply for permits from relevant research ethical boards in Norway. (pending final clarification) Storage of data collected from field trails will be anonymized or based on the sensor unit it is collected from. Should the data be combined with other data sets to create data with new information, such as personal performance of a squad, the data might be counted as sensitive. The project will use the TREEADS data management plan and appointed data protection officer at each partner organization.
Informed consent from participants in field work	Informed consent may be required for firefighters in field work and for storage of data related to firefighters. Guidelines given by the TREEADS ethical manager will be followed.

ITALIAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

The Italian Pilot is related to the territory of the Campania Region, in southern Italy. The Campania Region has a total surface of 1,359,354 ha, more than 30% of which are occupied by forest areas with an increase in wooded areas of approximately 9.36% over the decade 2005/2015 (source: RaF Italia 2017-2018 – Report on the state of forests and the forestry sector in Italy).The region overlooks the Tyrrhenian Sea with around 360 km of coastline, between the mouth of the Garigliano river (north) and the gulf of Policastro (South).The coast is low and sandy for long stretches, while it is high, jagged and engraved by deep gorges, in correspondence with the Lattari Mountains (the Sorrento Peninsula) and for some stretches of Cilento. The pilot case focus is on a very important touristic area, the Sorrento Peninsula, that divides the gulfs of Naples and of Salerno. The Sorrento Peninsula includes high density urban settlements and very dense wooded areas on the slopes. The location of the Sorrento Peninsula is shown in Figure 2. The ridge of the Sorrento Peninsula in the proposed area rises up to 500 m above sea level and the slopes are often subjected to extreme wildfires (both natural or malicious); in 2017 a very big fire involved different areas in Campania Region but in particular around the Vesuvius, causing also interruption in public transportation services.

The characteristics of wildfires in the southern Italian landscape typically fit the Mediterranean profile of wildfire development and proliferation. Mediterranean ecosystems are characterized by high biodiversity, with a flora consisting of a wide variety of tree, shrub and herbaceous species. The common feature to the climatic area of the region concerns the irregular distribution of rains, which show an autumn-winter maximum and a summer minimum, the latter mitigated by the altitude. This is a peculiar rainfall distribution of the Mediterranean climate. There is a close correlation between climate and vegetation (potential and real) present in the area. The

Region has prepared a map of the phytoclimatic zones, created through the classification procedure proposed by PAVARI that frames each territorial area in a representative phytoclimatic area of a climatic scenario and of a vegetation scenario: the Sorrento Peninsula falls entirely in the sub-zone Lauretum (warm on the coast and medium to cold on the hills).

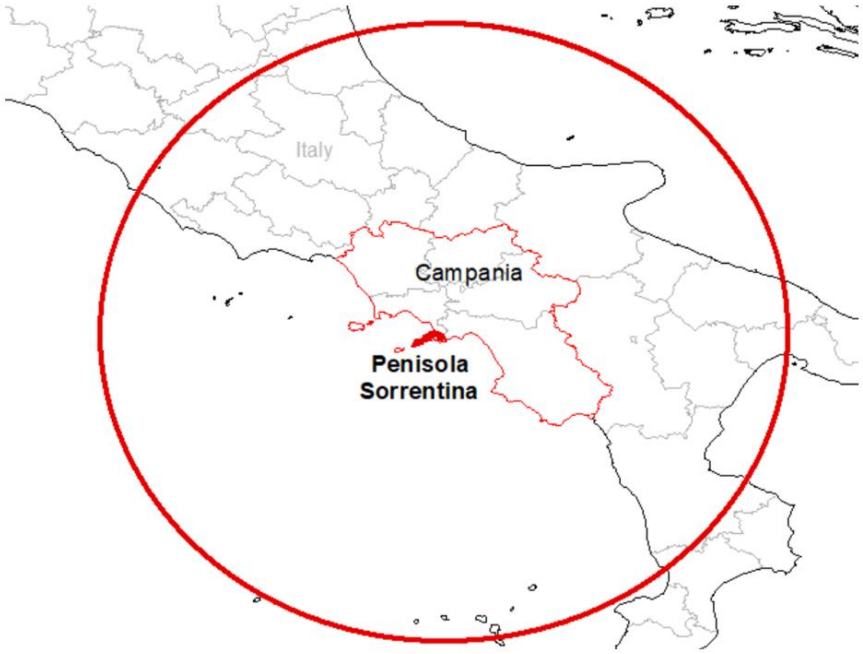


Figure 2: Location of the Italian pilot, marked in red.

The area of the Sorrento Peninsula also hosts very important sites from the Natura 200 network related to both the hilltops and the marine area surrounding the peninsula, the Sorrento territory hosts a very important natural area, the pine forest called "Le Tore" because it relates to the ancient name of the hill, precisely Monte Tore. It is an area owned by the Municipality of Sorrento which was once characterized by the presence of oak species and Mediterranean scrub. Throughout the 1900's the area has been reforested with various essences of trees: chestnut, Neapolitan alder and Mediterranean pine. The area was destroyed various times and always restored with: Pinus halepensis (Aleppo pine) and Pinus pinaster (maritime pine) together with some individuals of stone pine. The area is a very important environmental asset for the Sorrento municipality that is currently engaged and committed to its protection and enhancement.

From the accessibility point of view the entire peninsula is served by a single main road running around the coast and by a train line (Circumvesuviana Railway) running only on the Sorrento side of the Peninsula. In addition, a cable car system will be built to connect a sea level location to the ridge of the Sorrento Peninsula, to integrate the regional rail transport system with connection to remote areas only reachable by car. An ongoing feasibility study promoted by ACAMIR, the Regional Transportation Agency, aims at defining the optimal solutions for such infrastructure.

The overall pilot activities will be focused on the validation of different TREEADS features. In particular, the **Infrastructures Fire Emergency Management Strategy** will be applied to support the design of the Cable Car System; the applicability of **eco-sustainable construction materials/components with improved fire performances** will be assessed as both a preventive action or restoration action for infrastructures exposed to wildfires and, finally, **Preventive risk analysis** for wildfires in protected forest areas and **Risk Transfer solutions** and **Analysis of possible economic restoration solutions** will be studied for the pilot area and for the protected natural areas in particular. Finally, a **Fire detection and Response simulation in real environment** will be planned and performed in the Sorrento area.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the Italian pilot campaign and the TREEADS consortium are given in Table 10. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 11.

Table 10: TREEADS partners and their roles in the Italian pilot campaign.

Partner	Role	Short description of responsibilities
STRESS	Pilot leader	STRESS is the leader of the task and will be responsible for planning, organizing, and managing the execution of the different actions
Tecnosistem	Pilot partner	STRESS's Associated Entity – will develop the Infrastructure's fire emergency management strategy and will apply it to the Cable Car Preliminary Design against fire.
RINA	Pilot partner	STRESS's Associated Entity – will validate the eco-sustainable construction materials/components developed in T4.7 and provide Guidelines
UNINA	Pilot partner	STRESS's Associated Entity – will perform the lab testing of eco-sustainable construction materials/components from T4.7 and provide Guidelines
ACaMIR	Pilot partner	Will participate to the Cable Car Design and provide data and support for the application of the Infrastructure's fire emergency management strategy.

Sorrento	Pilot partner	Will participate and support all the different actions related to its territory: Cable Car Layout, protection, and enhancement of its natural areas and for simulation in real environment.
USAL	Associated pilot partner	Will customize the Forest fire spread simulation tools to provide inputs for the infrastructure's fire emergency management strategy.
DTU	Associated pilot partner	Will propose Insurance Model and Risk Transfer Solutions, Cost-Benefit analysis on possible preventive actions and possible economic restoration solutions.
CBS	Social partner	Cost-effective suggestions and guidelines based on the pilot's contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
FI	Associated pilot partner	Will support the validation of its fire detection and decision support system in the Italian Pilot for the Fire detection and Response simulation in real environment activities.
PUI	Associated pilot partner	Will participate to the Fire detection and Response simulation in real environment activities.
SIMAVI	Associated pilot partner	Will support the validation of its VR/3D environment in the Italian Pilot to support the Fire detection and Response simulation in real environment activities.
NCSRD	Associated pilot partner	Will Support the Infrastructure's fire emergency management strategy with a contribution for passenger evacuation analyses.

Table 11: External participants/ key stakeholders involved in the Italian pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
CNASAS National Alpine and Speleological Rescue Corps	Campania Regional Service. Letter of intent provided: Participation in meetings, Conferences. Possible participation in simulation in real environment activities	E, M, W, F
CAI - Italian Alpine Club	Local section. Letter of intent provided: Participation in meetings, Project events, Think Tank. Possible participation in simulation in real environment activities	E, M, L, F
Parco Monti Lattari	Park Authority, Fundation. Letter of intent provided: Participation in Project events	E, M
MAREVIVO	Environmental Association. Letter of intent provided: Meetings, Conferences, Project, input to guidelines.	E, M, W, S, F, L
FAI - Italian Environmantal Fund	Possible participation in activities related to natural protected areas, input to guidelines.	E, M, W, F
WWF	Possible participation in activities related to natural protected areas. input to guidelines.	E, M, W, S, F, L
LEGA AMBIENTE	Possible participation in activities related to natural protected areas; input to guidelines.	E, M, W, S, F, L
Misc. stakeholders	As indicated in survey and at stakeholder workshop 11th November 2022.	
VVFF	Regional Fire Fighter Corps. Initial Contacts, Pending collaboration request	
Regional Civil Protection	Wildfire prevention, detection and response unit. Initial Contacts, Pending collaboration request	

PILOT OBJECTIVES AND KPIS

The Italian Pilot focuses mainly on prevention and preparedness, and detection and response, and addresses the following objectives:

- Validation of an innovative **Infrastructures Fire Emergency Management Strategy** applied to the design of a Cable-Car System in the Sorrento Peninsula
- Validation of **eco-sustainable construction materials with increased fire performances** developed in T4.7
- **Fire detection and Response** simulation in real environment
- **Preventive risk analysis in protected forest areas** and possible economic restoration solutions after forest fires

The Italian pilot targets the following long term KPIs as proposed by the EC:

- 50% of Natura 2000 protected areas to be fire-resilient
- 50% reduction in building losses
- 90% of losses from wildfires insured

In addition, the following specific KPIs have been identified by the following TREEADS partners:

- TECNOSISTEM (STRESS' Affiliated Entity):
  - Definition of the Heat Release Rate (HRR) Curve for mass transport design in wildfire case or external, undefined external source
  - Definition of an integrated, innovative approach to fire analysis in external area for critical infrastructure emergency management strategy in case of possible wildfires.
- RINA (STRESS' Affiliated Entity):
  - Fire resistance improvement compared to conventional concrete based on Ordinary Portland Cement ≥ 10%

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In "Annex 2: Italian pilot task 8.3", a detailed overview of activities and schedule for the pilot is provided". Here an overview is given.

- Activities (IT-01/02/03) are preparatory Pilot activities and, thus, related to all of the long term and specific KPIs.
- Activity (IT-04) is an activity connected to WP4 and directly related to the specific KPI for TECNOSISTEM on the *"Definition of the HRR Curve for mass transport design in wildfire case or external, undefined external source"* and to the long term KPI on *"50% of Natura 2000 protected areas to be fire-resilient "*.

- Activities (IT-05/06/07/08/09/10/11) are directly related to the specific KPI for TECNOSISTEM on the *"Definition of an integrated, innovative approach to fire analysis in external area for critical infrastructure emergency management strategy in case of possible wildfires".*
- Activities (IT-12/13/14/15/16/17) are directly related to the specific KPI for RINA on the "*Fire resistance improvement compared to conventional concrete based on Ordinary Portland Cement ≥ 10%"* and to the long term KPI on "*50% reduction in building losses* ".
- Activities (IT-18/19/20/21) are directly related to the long term KPI on *"50% of Natura 2000 protected areas to be fire-resilient "*
- Activities (IT-22/23/24/25) are directly related to all the long term KPI on *"50% of Natura 2000 protected areas to be fire-resilient", "50% reduction in building losses"* and, in particular, *"90% of losses from wildfires insured"*

The pilot leader will arrange regular monthly meetings with pilot partners, associated pilot partners (minimum quarterly) and key stakeholders (minimum every 6 months) to discuss progress. Workshops involving several partners and stakeholders will be arranged when necessary for the progress of the activity (minimum yearly). A stakeholder workshop has been arranged in M12.

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Italian pilot campaign is given in Table 12. A more detailed timeline is presented in Annex 2. Table 13 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 12: Overall timeline for the Italian pilot campaign.

Schedule	Description of activities planned
M13-M19	*Table-top exercises & preparations* (*here called phase 1)*- this activity includes Coordination and planning of the overall activities of the Pilot: *Validation of an innovative Infrastructures Fire Emergency Management Strategy applied to the design of a Cable-Car System in the Sorrento Peninsula (Validation of eco-sustainable construction materials with increased fire performances developed in T4.7, Fire detection and Response simulation in real environment, Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires.),* Survey on existing information and Collection of data for the different operational scenarios, Survey of relevant background information and relevant guidelines for activity Post-processing. Upgrade and customization of USAL modelling tools for their integration in the Infrastructures Fire Emergency Management Strategy.
M20-M26	*Execution part 1- Infrastructures Fire Emergency Management Strategy (here called phase 2)* this activity includes: Simulation of forest fires in the Sorrento Peninsula; Optimization of cable car layout. *Execution part 2: Validation of eco-sustainable construction materials with increased fire performances* - Manufacturing of concrete and AAM samples, Mix design optimisation and selection of the best performing mixes. *Execution part 3: Fire detection and Response simulation in real environment* - Planning of simulation actions in real environment *Execution part 4: Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires* - Preventive risk analysis for wildfires in protected forest areas.

M27-M33	*Execution part 1- Infrastructures Fire Emergency Management Strategy (here called phase 3)*- this activity includes: Analysis of temperature field on structural parts and main systems of cable car; Analysis of smoke and toxic species diffusion on cable car. Simulation of forest fires in the Sorrento Peninsula; Optimization of cable car layout. *Execution part 2: Validation of eco-sustainable construction materials with increased fire performances* - Mix design optimisation and selection of the best performing mixes (continues from Phase 2), Building elements or materials (e.g., blocks, plasters) manufacturing, Recommendation for end-users. *Execution part 3: Fire detection and Response simulation in real environment* - Creation of rules related to the possible situations will be created starting from the Regional Plan for Prediction, Prevention and Active Fight to Forest Wildfires, A virtual Model of a specific area will be provided to support VR simulation of various operations. *Execution part 4: Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires* - Identification of possible Risk Transfer solutions, Cost-Benefit analysis on possible preventive actions.
M34-M40	*Execution part 1- Infrastructures Fire Emergency Management Strategy (here called phase 4)* - this activity includes: Analysis of passenger evacuation, evaluation of liveability parameters during fire emergency; Evaluation of innovative mitigation measures and safety systems; Guideline development for the overall Infrastructures Fire Emergency Management Strategy. *Execution part 2: Validation of eco-sustainable construction materials with increased fire performances* - Mapping of possible areas of application of Nature-based and fire-resilient solution for restoration, Operative suggestions, and Guidelines to be proposed to local actors. *Execution part 3: Fire detection and Response simulation in real environment* - On field operations simulation. *Execution part 4: Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires* - Analysis of possible economic restoration solutions after forest fires.

Table 13: Activities with dependency on other activities, which could cause delays between activities in the Italian pilot campaign.

Activity	Dependency
Activities IT-5/6/7/8 /9/10/11/21/22 depend on Activity IT-04	The upgrade and customization of USAL modelling tools for Definition of the HRR Curve for mass transport design was not foreseen as a part of WP4. The results from this will give input to activity *Execution part 1, 3 and 4.* Delays in such activity can thus cause pilot delays; initial analyses have provided positive outputs.
Activity IT-5 depends on Activity IT-02	The Simulation of forest fires in the Sorrento Peninsula is based on detailed local data. Delays in the collection of local detailed cartography will cause cascading delays on all the activities included in *Execution part 1*.
Activities IT-15/16/17 depend on Activities IT-12/13/14 developed partly in WP4	The mapping of possible areas of application of Nature-based and fire-resilient solution for restoration and the development of Operative suggestions and Guidelines depend on the activities related to Task 4.7 in WP4.
Activities IT-22/23/24 depends on Activity IT-02/03	Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires, depend on the survey on existing information, collection of data and relevant background information.

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Fire Safety Engineering Technologies that will used in the pilot:

- Infrastructure Design Model (BIM)
- Computational Fluid Dynamics (CFD) 3D Analysis Tools
- Pedestrian evacuation Analysis tools

Data needed for the pilot activities:

- Topography and area characteristics
- Fuel Type
- Fuel Density and Distribution
- Fuel Types Characterization

Table 14: TREEADS technologies used in the Italian pilot campaign.

Technology	Responsible partner, Partners involved	Technology will be used in this main activity
Forest fire spread simulation, Wind field model, Atmospheric pollutants dispersion model (USAL)	STRESS, TECNOSISTEM, ACaMIR, USAL	Execution part 1: Infrastructures Fire Emergency Management Strategy - The technology will be adapted for its use in the HRR curve definition in non-confined areas Execution part 3: Fire detection and Response simulation in real environment - The technology will be used to provide inputs to other technologies CEF, Wildfire Response Engine (WRE).
Nature-based and fire-resilient solution for prevention and restoration	RINA, UNINA, NTUST	The technology will be validated in Execution part 2
Resilient, event-driven, context-aware fire detection and decision support for response processes	STRESS, Sorrento, FI, PUI	The technology will be validated in activity IT – 19/ 21.
VR TRAINING	STRESS, Sorrento, SIMAVI, PUI	The technology will be validated in activity IT – 20 / 21.

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 15: Plan for data collection and analysis in the Italian pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Topography, Fuel Type, Fuel Density and Distribution, Fuel Types Characterization	Regional, national databases	ACaMIR, STRESS	N/A	IT-02
Urban Planning, Local Needs & Constraints, Infrastructure Design Data, Safety Rules and Policies, Tenability Conditions & Human Health	Local, National & International Regulations and databases	TECNOSISTEM, Sorrento, STRESS	N/A	IT-06 IT-07 IT-08 IT-09 IT-10 IT-11
Physical, Mechanical and fire resistance characteristics of samples and components	Laboratory experiments	UNINA, RINA	N/A	IT-12 IT-13
Socio economic georeferenced data	Surveys, Structured databases	Sorrento, STRESS, DTU, CBS	N/A	IT-02 IT-22 IT-23 IT-24 IT-25

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Information on permits that may be required are given in Table 16. No specific permit is foreseen for Exercise 1, 2 and 4 activities.

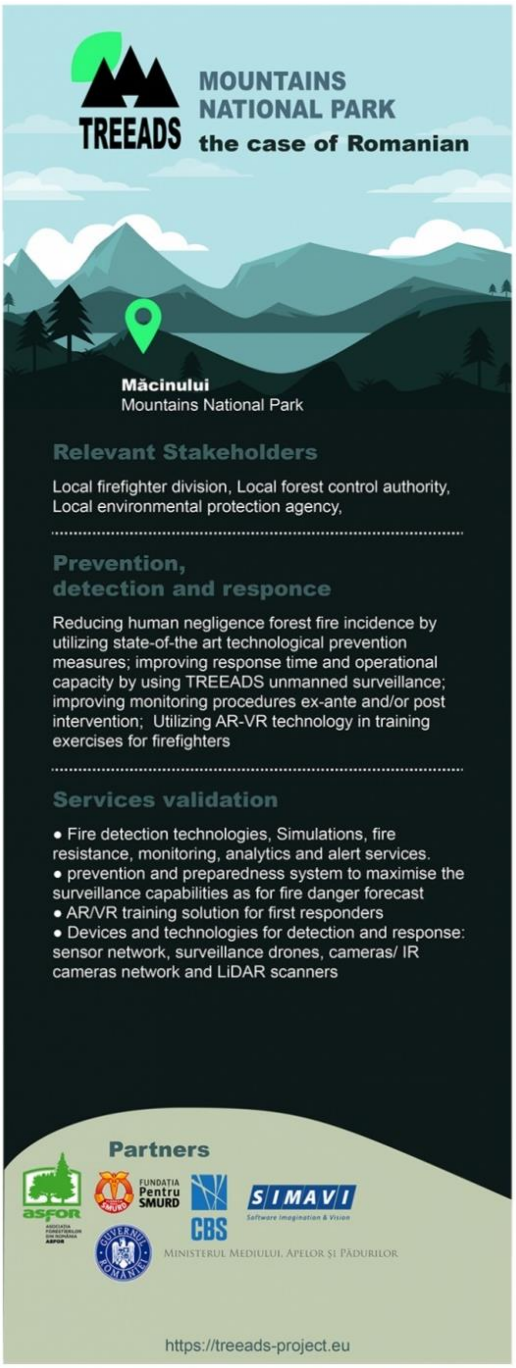
Table 16: Information on permits required and plan for obtaining these in the Italian pilot campaign.

Permit	Status/ plan
Possible permits could be required for IT-021	Local (municipal) civil protection will be involved in the *"On field operations simulations".* Regional Civil Protection and Regional Fire Fighter Corps have been contacted and their participation to activities has been requested.
Informed consent	Informed consent may be required where external partners are participating. Guidelines given by the TREEADS ethical manager will be followed.

ROMANIAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

At national level, there are on average 166 forest fires per year, with a total affected surface area of approx. 50kHa (data over the last 60 years). However, the average surface of forest fires has increased by 53% and their frequency has doubled in the last decade. National statistics show that 61% of forest fires start by human negligence and 35% are due to unknown causes, most likely also due to human error.



The use case is set in Macin Mountains National Park's, see Figure 3 for a map of the location. Its available natural potential is making it accessible to a wide range of tourists, interested in hiking, landscapes, flora, local fauna, studies and documentaries (documentations).

Among the identified vulnerabilities of the area are uncontrolled tourism, poaching, scattered grazing, illegal logging leading to the suppression of habitats, burning of vegetation, destruction of specimens of spontaneous flora, illegal capture of Dobrogean land turtles (Testudo graeca), extension of farms, extreme sports (off-road vehicles, ATVs, motorcycles) that disturb the tranquillity of the area.

Due to this abundance of visitors, human negligence is an important factor to consider in the prevention and mitigation of forest fires.

The use case will focus on the integration of SMART technology in forest fire prevention and intervention, with the aims of:

- reducing human negligence forest fire incidence by utilizing state-of-the art technological prevention measures
- improving response time and operational capacity by using SMART modelling
- Utilizing AR-VR technology in training exercises for firefighters

Figure 3: Location of the Romanian pilot, marked in red.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the Romanian pilot campaign and the TREEADS consortium are given in Table 17. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 18.

Table 17: TREEADS partners and their roles in the Romanian pilot campaign.

Partner	Role	Short description of responsibilities
ASFOR	Pilot leader	Provide overall coordination of pilot activities and facilitate cooperation between involved stakeholders at local level.
SMURD	Pilot partner	Liaison with local fire fighters. Facilitate the participation of local firefighters, together with logistical organization for the activities.
MEWF	Pilot partner	Dissemination of results at policy level dimension.
SIMAVI	Pilot partner	In charge with developing AR/VR training and demonstration modules. AR helmet, VR Training for the detection and response

CBS	Associated pilot partner	Cost-effective suggestions and guidelines based on the pilots' contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
DTU	Associated pilot partner	If applicable, economic assessments of impacts, preventive actions and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested
		Potential partners
FI	Potential pilot partner	Context-aware decision support, validation of its fire detection and decision support system. If involved, they will support the validation of its fire detection and decision support system in the Romanian Pilot for the Fire detection and Response simulation in real environment activities for the prevention and preparedness, detection and response
USAL	Potential pilot partner	Fire Prevention System. If involved, they will customize the Forest fire spread simulation tools to provide inputs for the Infrastructure's fire emergency management strategy for the phase of prevention and preparedness

Table 18: External participants/ key stakeholders involved in the Romanian pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
Macin Mountains National Park	Provides access to the natural park where the pilot is located	E, M, F
Local firefighters (ISU Tulcea)	Availability of firefighters and equipment for the pilot exercise	E, M, F
Forest owners	Uptake of procedures and process	E, M, W
Local forestry companies	Dissemination of results	E, M, W

PILOT OBJECTIVES AND KPIS

The pilot aims of reducing human negligence forest fire incidence by utilizing state-of-the art technological prevention measures. An ultimate goal is to reduce the incidence of forest fires by 50% through the use of proactive preventive approach that makes use of state of-the art technology.

Prevention:

There is a need to improve the monitoring of the protected natural park area that is within the scope of the pilot project. Ideally there will be a proximity monitoring system put in place that, using AI intelligence can interpret streams of data in order to provide a fire prevention system, together with an insurance model for possible preventive actions. Catastrophe modelling will provide the financial impact of a forest fire and serve as a basis for decision in case of a triggering event that warrants a response.

Detection and response:

The system put in place during the prevention phase should be able to provide the relevant training and tactical information to first responders in order to prepare and tackle the intervention in an efficient manner. The fire detection and decision support will provide firefighters with relevant information for an efficient response during the intervention.

Table 19: KPSs for the Romanian pilot campaign.

KPI	Current value – Desired value	Impact within the TREEADS project	Relative priority
Number of sensor networks installed	0 – 10	Major impact in monitoring the pilot	High
Forward command centre	0 – 1	Reducing the time of response for firefighters	High
Firefighters trained with AR/VR	0 – min 6		
Drone deployment	1 - 3		
Min 4G communication bandwidth	0 – 1		
Decisions support system for pre-arrival assessment of fire	0 - 1		

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

Activities in the Romanian pilot campaign are connected to the following two main operational scenarios:

- Prevention and preparedness
- Detection and Response

In Annex 3, a detailed overview of activities and schedule for the Romanian pilot is provided. Here an overview is given.

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Romanian pilot campaign is given in Table 20. A more detailed timeline is presented in Annex 3. Table 21 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 20: Overall timeline for the Romanian pilot campaign.

Schedule	Description of activities planned
M13-M19	*Table-top exercises & preparations* - this activity includes Coordination and planning of the overall activities of the Pilot, surveys on key information needed, preparation on AR/VR model and possible structure for integration with TREEADS platform.
M19-M33	Field visits at Romanian pilot site that aim to mount the relevant infrastructure, collect the necessary data for the different modelling instruments, develop the AR/VR module and conduct training sessions with firefighters. Potential activities include the connectivity of different modules with TREEADS platform.
M29-M33	Fire detection and response simulation in real environment will target the planning and execution of a fire exercise in the Macin mountains pilot location. Potential activities include the integration of different modules with TREEADS platform for the fire exercise.
M34-M40	Post-processing phase will analyse the comparison of training simulation results with actual real environment simulation, report on potential improvement of existing fire intervention procedures, and disseminate results at national level.

Table 21: Activities with dependency on other activities in the Romanian pilot campaign.

Activities	Dependency
Activities RO-13 depend on Activity RO-08/09	The integration of different modules into the TREEADS platform depends on the instalment of infrastructure for data gathering.
Activity RO-16 depends on Activity RO-05	The Simulation of forest fires in the Mounts Măcinului Park is based on detailed local data. Delays in the collection of local detailed cartography will cause cascading delays on all the activities included in *Execution part 1*. The activity will be developed in summer to avoid delays caused for the atmosphere

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Below is a proposed list of technologies to be addressed in the pilot. The list is still subject to discussions and approvals with the technology providers and should not be considered as binding at this stage, rather a range of possibilities.

Table 22: TREEADS technologies used in the Romanian pilot campaign.

Technology	Responsible partner, Partners involved	Technology will be used in this main activity
AR helmet	SIMAVI	Prevention and preparedness
VR Training	SIMAVI	Prevention and preparedness
	Potential technologies	
Context-aware decision support, validation of fire detection and decision support system	FI - potential partner	Will support the validation of fire detection and decision support system in the Romanian Pilot for the Fire detection and Response simulation in real environment activities for the prevention and preparedness, detection and response
Fire Prevention System	USAL - potential partner	Will customize the Forest fire spread simulation tools to provide inputs for the Infrastructure's fire emergency management strategy for the phase of prevention and preparedness

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 23: Plan for data collection and analysis in the Romanian pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Local topography and landscape, Local Needs & Constraints, Infrastructure Design Data, Safety Rules and Policies, Tenability Conditions & Human Health, National legislation	Surveys, Local, National & International Regulations and databases	SIMAVI	N/A	RO-05 RO-12 RO-13 RO-15
Data collection related to potential partners and potential technologies for the pilot				
Context-aware decision support, validation of its fire detection and decision support system	Surveys, Local, National & International Regulations and databases	FI	N/A	RO-06 RO-13
Using models for Fire Prevention System customize the Forest fire spread simulation tools	Regional, national databases	USAL	N/A	RO-13 RO-15

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Table 24: Information on permits required and plan for obtaining these in the Romanian pilot campaign.

Permits	Status/ plan
Permits could be required for RO – 08, RO – 09, RO – 12, RO – 16, RO – 17.	Permits for accessing the Natural park, installing the infrastructure, training of firefighters, structuring an intervention plan for the fire exercise, conducting the fire exercise and submitting recommendations need special permits. Discussions have been already held and verbal agreements have been given by all involved stakeholders.
Informed consent	Informed consent may be required where external partners are participating and where data related to them is stored (e.g., AR helmets). Guidelines given by the TREEADS ethical manager will be followed.

SPANISH PILOT

BACKGROUND AND PURPOSE OF THE PILOT

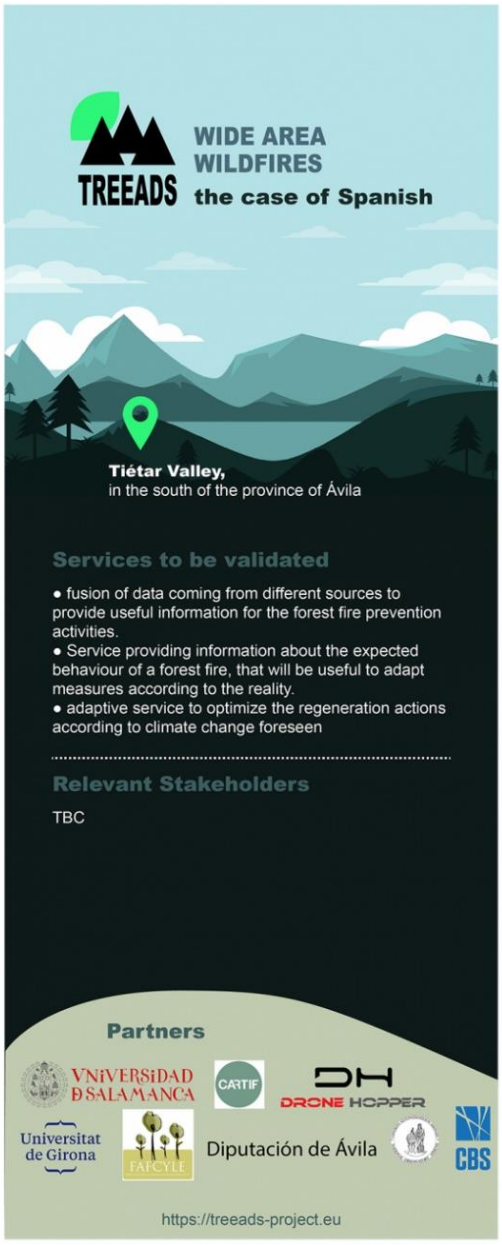
The southern area of Ávila is the most important forest area in terms of forest surface, with the massive presence of Pinus species and mixed forests. This area together with all its municipalities is considered as "High Risk Zone" according to the regional and national administration.

The phenomenon of forest fires has become one of the biggest environmental problems that our mountains suffer due to the high frequency and intensity that it has acquired in recent decades

A Mediterranean climate, marked by increasingly intense and long-lasting periods of drought (accentuated by climate change), the abandonment of tasks associated with rural life that has caused an increase in the amount of flammable vegetation and the associated increase in risk to the lack of prevention in the urban-forest interface, make up the scenario in which forest fires are generated in Spain.

All this, together with the existence of limited means of extinction and the insufficient prevention policy associated with sustainable forest management, endangers many areas of Spain every summer, as is the case of the province of Ávila in the region of Castilla y León.

The demonstration sites will be strategic points in the south of Ávila province covering all the types of forest lands existing in the area, regarding different criteria, such as: proximity to urban areas, available infrastructures, the potential input data collection, forest land ownership and type of trees. A map showing the location is given in Figure 4. Regarding the available infrastructures, there are regional infrastructures that can be located and coordinated with the activities, such as an extinction base. There are infrastructures provided by the municipalities as well that will be collected and standardized in a database to offer accurate information to extinction resources.



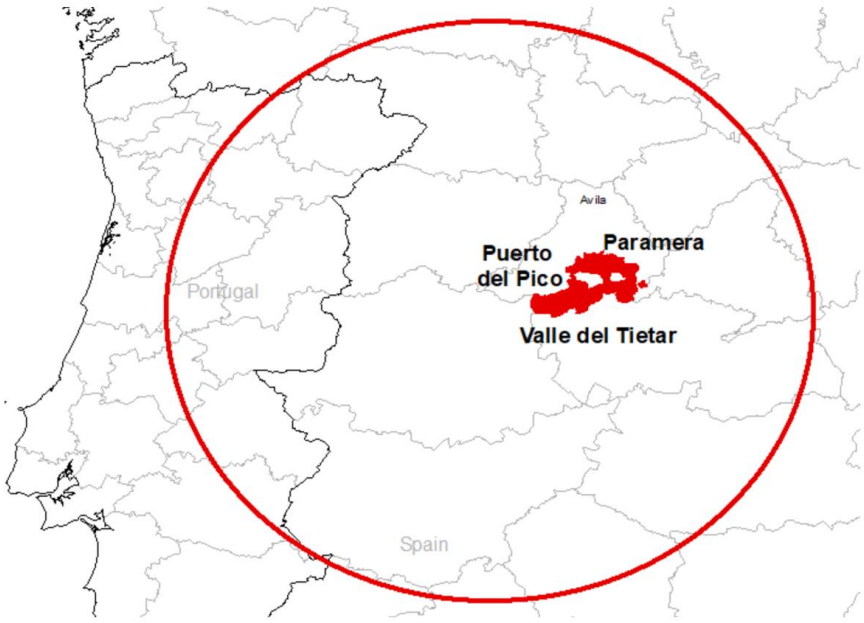


Figure 4: Location of the Spanish pilot, marked in red.

The application of the holistic fire management approach proposed in TREEADS will be narrowed to some municipalities or forest owners' surface, according to the potential application of the foreseen technologies, which will be tested and validated in the Tiétar Valley. The most parts of the pilot area are from private owners, while the forests in the centre of the province are mostly from public ownership.

The impacts of climate change expected in the province of Ávila are:

- Reduction of water availability.
- Increase in the virulence of forest fires.
- Extension of the areas affected by plagues and diseases.
- Increase in the intensity of downpours, rainfalls, and erosion processes.
- Increase in the frequency of destructive windstorms in forest areas.
- Modification of phenology and physiology of forest species.

The purpose of this pilot, beyond the specific objectives described below, is to demonstrate the usefulness and possibilities of TREEAD as a powerful support tool in the three phases of a forest fire to a population environment that is highly sensitive to forest fires due to its economic dependence on the rural environment and who have already suffered vital, economic losses and other direct or indirect consequences of past forest fires.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the Spanish pilot campaign and the TREEADS consortium are given in Table 25. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 26.

Table 25: TREEADS partners and their roles in the Spanish pilot campaign.

Partner	Role	Short description of responsibilities
Capgemini Engineering	Pilot leader	The leader of the task. Capgemini will be responsible for planning, organizing, coordinate and executing the field exercises.
ECOSAT	Aerial means provider	To provide the HAP (High Altitude Platform) for surveillance and monitoring activities in the Spanish pilot case
DdA	Public middle management	Public representative Facilitate contact between project partners involved in the pilot and public entities Facilitate contact between project partners involved in the pilot and fire brigades
FAFCYLE	End user	Verify that the pilot actions meet the needs of end users and stakeholders. Facilitate contact between project partners involved in the pilot and stakeholders. Contribute ideas and knowledge in forest management where necessary
USAL	WP4 leader (Prevention), Platform Leader	USAL will lead the development of the platform (3.6) that will manage the three main phases in wildfires (prevention, response, restoration). USAL will also lead the prevention phase and will provide support to the different requirements for prevention. In particular, USAL will provide simulation (4.2) and forest mapping (4.5) capabilities in prevention
UdG	Environmental partner	Provide and test post-fire environmental assessment protocols and information for the Spanish pilot. Provide post-fire management and restoration knowledge and techniques

DH	Drone provider	Firefighting drones Cooling down drones
NOA	Fire risk & burnt area mapping provider	Responsible for burnt area mapping and fire risk assessment
DTU	Associated Pilot Partner	Cost-Benefit analysis on possible preventive actions and possible economic restoration solutions. If applicable, will propose insurance and (economic) risk transfer solutions
CARTIF	Technology Provider	Focused on the treatment of imagery data, especially satellite data but also combined with other sources, we will develop a tool and indicators based on different components (mainly a tool for extracting agroforestry indices) to improve the decision-making process in the Spanish pilot case
CBS	Social Partner	Cost-effective suggestions and guidelines based on the pilots' contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
ACCELI	Technology / UAV Provider	LiDAR Drones Vision Drones Seed pod dissemination Drones
GBD	Technology provider	Special seed pods for restoration
8BELLS	Technology Provider	8BELLS will provide the following technological tools: - 5G portable Communication System - AR helmet for Fire Fighters - Black Box IoT platform (including a Thermal Camera for forest surveillance)
CERTH	UAV provider	AI for mission planning and swarm coordination Visual object recognition on embedded systems

GBD – LAMMC	Technical partner	Biomaterial for restoration. Responsible for SCC content/seedball production and adaptation to local conditions

Table 26: External participants/ key stakeholders involved in the Spanish pilot campaign, and planned communication methods.

Participant	Short description of expected contribution	Communication method
Regional government (Junta de Castilla y León)	Support in task associated with the three phases: prevention, response and restauration Providers of information and permissions of their competition	Email and phone
Asociación Pedro Bernardo Siempre Verde	Support in tasks associated with restauration tests (locations, types of vegetation, etc.)	Email and phone
Local councils	Information to citizens Providers of information and permissions of their competition	Email and phone
Firefighters	Support in tasks associated with response test	Email and phone
Civil Protection and emergencies	Support in tasks associated with response test	Email and phone

PILOT OBJECTIVES AND KPIS

The main objective of Spanish pilot is deployment of innovative tools that allow to support the three main phases in a fire (pre-fire, active fire and post-fire). For this general goal, there are separate objectives that will be considered:

- Collect data through a transversal deployment at different levels, obtaining data from different altitudes and testing with sensors installed at ground level, integrating Copernicus satellite data with the use of two additional aerial platforms (High Altitude Platform and drones).
- Data interpretation (applying technics on computer vision, AI, and knowledge extraction) and giving feedback with the objective to provide information to the stages foreseen by the project.

- Model the expected evolution of forest in terms of vegetal material and to prevent the hotspots in terms of forest risks using information from multispectral and thermal inputs crossed to geographical data.
- Make it easy the access to key information about the location of resources like water source points, road accesses and state of it, resources for securing people, etc.
- Monitoring the evolution of forest fires to support decision making chains of forest fire extinction resources.
- Providing immediate post fire information on fire severity and ecosystem vulnerability to analyse environmental impact.
- Provide site-specific technical recommendations for ecosystem management and potential restoration interventions using all information collects, together socioeconomic variables, biodiversity indices and climate change scenarios
- Learning from past activities to improve future interventions in burned and managed areas through an adaptive management system that feeds mid-term monitoring of environmental variables (by satellite, HAP, drones, in-situ sensors, and field work).

In summary, our intention with this pilot is to validate:

- **The fusion of data** (coming from different sources, like satellite, inputs from aerial platforms (HAP) and on-ground sensors (in-situ monitoring), **to provide useful information for the forest fire prevention and preparation activities**. This data will be integrated and analyzed offering risks indicators about the fire, based on user-friendly and GIS based visualization tools
- **Forest fire-fighters support** with information to protect fire fighters **during the extinction**, offering them information about the exit routes, the existence of protection buildings and infrastructures and the indicators to leave a fire and protect themselves. It will be done thanks to simulation actions carried out by USAL who has experience in this regard
- **The fusion of data** (coming from different sources, like satellite, inputs from aerial platforms and on-ground sensors, **to provide useful goal-driven information for the forest fire restoration and adaptation activities**.

In the Spanish pilot, the following long term KPIs as proposed by the EC are targeted:

- Work area covered by working hours with TREEADS support
- % Of risk reduction in an operation using TREEADS support
- Operations performance assessments against historical data in terms of area
- Difference between desired biomass volume to reduce and real volume reduced
- Area covered by vision devices
- Accuracy of each report
- Improvement in recovery times using priorities tools
- Improvement in prevention on-field operations times using priorities tools
- Cartography precision

- Number of features/information units per report
- Time to obtain the full report for the selected area
- Update rates
- Deployment logistic costs
- Time unit to start Early Warning System
- Time to generate cartography using deployed resources
- Number of people achieved using RRSS
- Number of interactions using RRSS
- Time from fire start to detection and report
- Fire report localization accuracy
- Aerial firefighting drones time from base to fire objective
- Time to full extinction using firefighting drones (in terms of area/hour)
- Aerial firefighting drones model autonomy
- Aerial firefighting drones model fuel consumption (litres/kilometres)
- Improvement in recovery times using priorities tools
- End-user (testers) evaluation Surveys

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In Annex 4, a detailed overview of activities proposed to schedule in the pilot is provided, including brief description, validation goal and KPIs. Here we will include only activities related with the measurement collection and its relationship with KPIs, and not the logistic and coordination ones.

It is important to highlight that the activities detailed in Annex 4 at this stage of the task are defined in the form of a proposal and must be validated by the members of the pilot once they have defined their participation role after the definitive selection of the locations based on requirements. Logistic and operational

This implies that not all the proposed activities are expected to be carried out, but enough to meet the validation requirements for data fusion and support for firefighting units that include the participation of all pilot participants.

Here an overview of these proposed activities:

- Logistic deployment exercises to measure deployment costs and limitations, including flying tests and connectivity tests
- Downgrade risk in area competition to compare supported/unsupported performance considering some indexes (in coordination with municipalities and associations) involves NOA, CARTIF, USAL
- High risk municipality TREEADS preparation: to evaluate deployment costs, accuracy, performance, response times, reach using social networks, etc (in coordination with municipalities) involves all the partners except DTU

- TREEADS detection system vs Traditional protocols (localization accuracy, times) (in coordination with fire brigades in a controlled burning) involves NOA, CARTIF, USAL, ECOSAT, ACCELI
- UAV for fire Extinction exercise (in coordination with fire brigades in a controlled burning) involves DH
- UAV for fire cooldown hotspot detected using UAVs for Thermal Vision exercise (in coordination with fire brigades in a controlled burning) involves DH, ECOSAT, ACCELI, USAL, 8BELLS
- Firefighter's support using TREEADS with 5G helmets connected to a portable communication station against traditional Radio communication exercise (in coordination with fire brigades) involves 8BELLS
- Re-evaluation of already restored areas using goal-driven decision support with different goals and parameters, to evaluate impact and compare results with actual state of the area, including socioeconomic impact. (in coordination with municipalities and associations) Involves UdG, DTU
- Burning areas evaluation to compare technologies (in coordination with municipalities, landowners and postfire brigades) involves UdG
- "How useful is to priories what do you want to do with your forest", to evaluate how useful is goal driven decision support for restoration and adaptation for landowners and associations (in coordination with municipalities, landowners and associations) involves UdG, USAL

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Spanish pilot campaign is given in Table 27. A more detailed timeline is presented in Annex 4. Table 28 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 27: Overall timeline for the Spanish pilot campaign.

Schedule	Description of activities planned
M13-M19 (P1)	***Field exercises definition***: This activity includes the planning of all the activities in the pilot: 1. Design of field exercises. Definition of scenarios. Final selection of field exercises and execution commitment through the definition of roles for each partner per exercise. 2. Extraction of minimum logistical requirements for the deployment of physical elements provided by partners (Storage Logistics, Special Transport, Legal permits, Additional HR, Maximum distance to the exercise, Deploy Logistics, connectivity, power details, Time to full charge, autonomy) 3. Selection of locations from among the candidates visited at the Avila Meeting for the selected exercises in (1) considering the logistical requirements from (2) for feasibility 4. Definition of participants per exercise considering stakeholders (fire brigades for controlled burns; volunteer corps for prevention, preparation, restoration, or adaptation tasks; local area managers) and test teams 5. Refinement of user stories (iterations) to adapt them to localizations and requirements. Definition of use case for each exercise, including sequence Diagrams for each use case/exercise. 6. Communication with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers to evaluate possible collaborations. Initial scrutiny of eventual collaborators (Voluntary participation in TREEADS survey). Survey on the relevance of the proposed exercises as a platform evaluation measure 7. Compilation of historical information and collection of public sources with relevant information of the area or historical data related to wildfires 8. Define an on-field exercises execution plan, considering an incremental deployment of the solution TREEADS related with logistic and stational (official controlled burns dates, biomass prevention dates) requirements

M20-M26 (P2)

***Logistic and Field exercises preparation**:*

This activity includes the logistic preparation and coordination of all the activities in the pilot. Involves the participation of FAFCYLE and DipAvila:

1. Operational definition by localized field exercise.
2. Study of the final area to verify compliance with logistic requirements.
3. Selection of candidate spaces for storage logistics. Check electrical sources.
4. Feasibility study of logistics candidates, study of costs and evaluation of logistics coordination.
5. Final selection of logistic spaces per exercise. Final exercise Plan considering minimum logistic impact.
6. Logistic Management and coordination with area managers and owners considering Exercises Planification (5).
7. Coordination of field exercises with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers. Selection of possible collaborators (Voluntary participation survey). Study of legal implications of external participation. Safety and security protocols definition.

***Execution part 1**:*

In this first phase of execution, we will focus on field exercises in the locations selected in the province of Ávila that do not require large logistical deployments and allow us to test the platform (WP7 Dependency) incrementally. Its mandatory the use of the TREEADS platform in field exercises. Involves the participation of technological partners.

We will therefore begin with the exercises related to deploying the technologies linked to the consumption of Copernicus information (NOA, CARTIF) to continue with elements of the solution that can provide support without the need to use all the physical means deployed in real time (prevention technologies from USAL, restoration, and adaption technologies from DTU and UdG, RRSS tools from CERTH).

The exercises in this phase will be supported using historical data, and will be focus on:

8. Test the first integrated software functionalities of the platform (WP7 dependency)
9. Prevention exercises that do not require of near-real time reports - do not require the deployment of aerial means and PCS-, including on-field operations using TREEADS knowledge
10. Preparation/prevention exercises related with RRSS exploitation

11. Restoration/adaptation exercises including on-field operations and the use of historical data, and the report generation. These exercises could include de deployment of UdG UAV, depending on logistics
12. Fire spread Simulations

In this execution part we will try to also work with team volunteers. We will take some measurements:

- Area covered with different tools
- Accuracy of each report
- Improvement in recovery times using priorities tools
- Improvement in prevention on-field operations times using priorities tools
- Fire risk reduction in area after supported on-field operation using TREEADS
- Operations performance assessments against historical data
- Difference between desired biomass volume to reduce and real volume reduced
- Reported data accuracy
- Accuracy assessment of TREEADS reports against existing data
- Number of features/information units of TREEADS report against existing data
- Time to obtain the full report for the selected area
- Update rates
- Number of people achieved using RRSS
- Number of interactions using RRSS
- End-user (testers) evaluation Surveys

Integration of the measurements into the TREEADS platform. Integrating the field measurements into the test methods in *Execution part 2.*

M27-M33 (P3)

***Deployment Logistic tests and Execution part 2 preparation**:*

In the first part of phase 3, after logistic preparation, we are dedicated to carrying out deployment exercises that demonstrate the logistical feasibility of a physical deployment of the TREEADS technologies. Involves the participation of technological partners with physical devices.

1. Individual flight tests of the aerial means (Zeppelin, Drones), estimating autonomy and taking measurements of interest (max distance to target, altitude, etc.)
2. mobile coverage deployment tests (PCS) measuring the limits of connectivity and the available bandwidth by zones
3. connectivity tests between the physical elements of the TREEADS ecosystem,
4. tests of sending data from sensors to the platform
5. tests of drone's swarm coordination
6. test drone seed pods dissemination in easy access area

These exercises will help to describe a deployment methodology and obtain values of interest (performance, limitations, times, operational costs).

They will also serve to refine the Execution part 2 planification, with the most critical field exercises, especially those related to the use of a Zeppelin and those related to the use of drones for firefighting and hot spot cooling.

Integration of the measurements and logistics into the TREEADS platform. Integration of the field measurements into the test methods in *Execution part 2.*

***Execution part 2**:*

The second part of the phase and of the pilot execution will have the mission of carrying out the most ambitious exercises of the pilot, these are those related to a complete or near- complete physical deployment of the solution. Its mandatory the use of the TREEADS platform in field exercises. Involves the participation of all the partners.

The logistic for this exercise are critical and Is mandatory to coordinate it with a controlled burning carried out by the fire brigades, so that the preparation exercise is linked to the detection and extinction exercises, to minimize the impact as far as possible.

The exercises in this phase will integrate the functionality tested in Execution part 1 and will be focus on:

7. The feasibility to deploy full TREEADS power
    - Here we will take measures related to economic costs

8. The preparation of a high-risk area–- which will imply the deployment of an alarm system and a complete monitoring of the terrain using all available physical means, together with the mobilization of relevant resources in case of fire (PCS, helmets, drones). We will take some measures:
    - Area covered by vision devices
    - Cartography precision
    - Number of features/information units per report
    - Time to obtain the full report for the selected area
    - Update rates
    - Time unit to start Early Warning System
    - Time to generate cartography using deployed resources
    - Number of people achieved using RRSS
    - Number of interactions using RRSS
    - Fire report localization accuracy
    - (litres/kilometres)
9. Fire detection using Aerial means and Early warning System. Includes hotspot detection tests. We will take some measures:
    - Time from fire start to detection and report
    - Time to send alarms
    - Fire localization accuracy
10. Fire extinguishing -exercise on controlled fire- using unmanned aerial means. We will take some measures:
    - Aerial firefighting drones time from base to fire objective
    - Time to full extinction using firefighting drones (in terms of area/hour)
    - Aerial firefighting drones model autonomy
    - Aerial firefighting drones model fuel consumption
    - Aerial firefighting UAV extinction time against traditional extinction means time
    - Times and performance comparation with other means
11. Cooling down of hot spots detected by treads (USAL) through the use of UAV (DH). We will take some measures:
    - Aerial firefighting drones time from base to objective
    - Time to full cooldown using firefighting drones (in terms of area/hour)
    - Aerial firefighting drones model autonomy (different model for cool down)
    - Aerial firefighting drones model fuel consumption (different model for cool down)
    - Times and performance comparation with other means
12. Seed pods dissemination in difficult access area using UAV. We will take some measures:
    - Soil Penetration

	• Soil state • Minimum Shoot velocity • Disseminated seed pods/time unit • Area covered/time unit • Performance in difficult access area against human team performance Satisfaction surveys for external participants and public present in this execution exercises. Integration of the results into the TREEADS platform.
M34-M40 (P4)	***Post-processing:*** This task is related to the evaluation of the measures collected in the different executions, the formalization of this data, the creation of a document of suggestions for the support of the decision and the operation based on the evaluation of the execution parts results, and a final section of conclusions, successes and errors, possible improvements, and future work. The tasks will be: 1. Summary of activities carried out in the pilots based on the field diary 2. Collection of information and measurements of the exercises of the different executions. 3. Evaluation measures collected in the different exercises. 4. Evaluation of costs/benefits for each of the scenarios represented by the different phases of a forest fire (prevention, preparation, detection, response, restoration and adaptation) based on the measures collected in execution part 2. 5. Summary table of operation costs of each tool in logistical terms based on the execution costs. 6. Creation of a document of suggestions to support the decision and the operation for each of the phases of a forest fire. Within the framework of each of the phases of a wildfire, this document must include an end-user tools guide, logistical requirements, tool functionality, tool target and a simple example of use. This document must include all the tools implemented in the Spanish pilot. 7. Conclusions, successes and errors, possible improvements, and future work

Table 28: Activities with dependency on other activities in the Spanish pilot campaign.

Activities	Dependency
Activity ES-03 depends on Activity ES-01 and ES-02	The selection of the location depends on the exercises and the logistic requirements
Activity ES-04 depends on Activity ES-03	The definition of the participants considering stakeholders depends on the selected locations
Activity ES-05 depends on Activity ES-03, ES-04	Redefinition to adapt user stories to ES-03 and ES-04 conclusions
Activity ES-06 depends on Activity ES-04	Communication with stakeholders depends on participants definition
Activity ES-08 depends on Activity ES-05	The definition of an execution plan depends on the refinement of user stories
Activity ES-09, ES-10, ES-11, ES-12 depends on Activity ES-03	All these tasks depend on the selected location in Activity ES-03
Activity ES-13 depends on Activity ES-12	Selection of logistic spaces depends on feasibility study and the evaluation of costs in activity ES-12
Activity ES-14 depends on Activity ES-13	Coordination depends on the logistic space selection
Activity ES-15 depends on Activity ES-04	Coordination depends on the participants definition and the selected locations
Activities ES-16, ES-17, ES-18, ES-19, ES-20 depends on WP7	These tasks depend on the platform implementation tasks, carried out in WP7
Activities ES-21, ES-22, ES-23, ES-24, ES-25, ES-26, ES-27 depends on ES-15	Deployment logistic tests depends on coordination on field exercises with stakeholders and government
Activity ES-28 depends on WP7	The integration of measurements depends on the Platform state

Activity ES-29 depends on Activities ES-15, ES-18, ES-21, ES-22, ES-23, ES-24, ES-25, ES-26 and WP7	The preparation task depends on logistic deployment tests, coordination task previous related activities (ES-18) and WP7 platform state
Activity ES-30 depends on ES-15, ES-17 ES-21, ES-22 and WP7	Fire detection using aerial means depends on coordination with stakeholders, aerial means logistic tests, previous related activity (ES-17) and WP7
Activity ES-31 depends on ES-15, ES-21, ES-22, ES-30 and WP7	Firefighting exercises depends on coordination with stakeholders, aerial mean logistic tests and previous tests related with (ES-30)
Activity ES-32 depends on ES-15, ES-21, ES-30 and WP7	Cooling down exercises depends on coordination with stakeholders, aerial mean logistic tests and previous tests related with (ES-30)
Activity ES-33 depends on ES-15, ES-21, ES-27	Seed pods dissemination exercise depends on coordination with stakeholders, aerial mean logistic tests and previous tests related with (ES-27)
Activity ES-34 depends on Activities ES-16, ES-17, ES-18, ES-19, ES-20, ES-29, ES-30, ES-31, ES-32, ES-33	Collection depends on execution activities
Activity ES-35 depends on Activity ES-34	Evaluation depends on collection measures
Activity ES-36 depends on Activity ES-34 and ES-35	Summary depends on Collection and evaluation
Activity ES-37 depends on Activity ES-34	Evaluation depends on collection measures
Activity ES-38 depends on Activity ES-34, ES-35, ES-37	Suggestions document to support the decision depends on collection of data and evaluations
Activity ES-39 depends on all activities	Conclusions depends on the full project experience

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Table 29: TREEADS technologies used in the Spanish pilot campaign.

Technology	Responsible partner, Partners involved	Technology will be used in this main activity
HAPs (Zeppelin) for hyperspectral images	ECOSAT	Deployment Logistic tests and Execution part 2 preparation Execution part 2
MCC van for processing linked with HAPs	ECOSAT	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone with Lidar for surveillance and reforest using seed pods	ACCELI	Deployment Logistic tests and Execution part 2 preparation UAV carrying a seed pods release mechanism of for reforestation Execution part 2
Drone for aerial images	ACCELI, UdG	Execution part 1 Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drones with LiDAR	ACCELI	Execution part 1 Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone for firefighting	DH	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone for cooldown hotspot	DH	Deployment Logistic tests and Execution part 2 preparation Execution part 2

Seed Pods	GBD	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Portable Communication System to provide 5G connectivity	8BELLS	Deployment Logistic tests and Execution part 2 preparation Execution part 2
5G helmets	8BELLS	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Accurate forest mapping	USAL	Execution part 1 Execution part 2
Fire prevention system	USAL	Execution part 1 Execution part 2
Earth Observation based toolkit for Fire Exposure and Risk assessment	CARTIF	Execution part 1 Execution part 2
Territorial assessment tool to evaluate climate related risks and vulnerabilities	CARTIF	Execution part 1 Execution part 2
Fire hazard forecasting using satellite data and machine learning models: FIRE PREDICTION RISK MODEL	NOA	Execution part 1 Execution part 2
Artificial Intelligence for mission planning & swarm coordination	CERTH	Deployment Logistic tests and Execution part 2 preparation Execution part 2

Forest spread simulation	USAL	Execution part 1 Execution part 2
Wind field model	USAL	Execution part 1 Execution part 2
Atmospheric pollutants dispersion model	USAL	Execution part 1 Execution part 2
Analysis of Fire Behavior and Spread for the Development of Safety Meassures	OVGU&BAM	Execution part 1 Execution part 2
Visual Object Recognition on embedded systems	CERTH	Deployment Logistic tests and Execution part 2 preparation Execution part 2
DSS restoration module	UdG	Execution part 1 Execution part 2
Burning area mapping	NOA	Execution part 1 Execution part 2
Seed pods for aerial dissemination using SCC for aerial mass releases	GBD	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Preparation of biomaterial for post-fire bioremediation and re-vegetation trails	LAMMC	Execution part 1 Execution part 2
Insurance Model and Risk Transfer Solutions	DTU	Execution part 1 Execution part 2

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 30: Plan for data collection and analysis in the Spanish pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Satellite images	COPERNICUS,	NOA, CARTIF, ECOSAT, ACCELI, UdG	N/A	Activity ES-29
Hyperspectral images	ECOSAT Zeppelin,	ECOSAT	N/A	Activity ES-29
Zeppelin telemetry	ECOSAT Zeppelin,	ECOSAT	N/A	Activity ES-22
Thermal images	ECOSAT Zeppelin, ACCELI Drones, UdG Drones	ECOSAT, ACCELI UdG	N/A	Activity ES-29
EO Images	ECOSAT Zeppelin, ACCELI Drones, UdG Drones	ECOSAT, ACCELI UdG	N/A	Activity ES-29
LiDAR (point clouds)	ACCELI Drones	ACCELI	N/A	Activity ES-29
UAV telemetry	ACCELI Drones UdG Drones DH	ACCELI Drones UdG Drones DH drones	N/A	Activity ES-22
Weather data	Public databases Field work	USAL	N/A	Activity ES-17
Soil data	Field work	LAMMC	N/A	Activity ES-19
Soil Seed penetration data	Field work	GBD	N/A	Activity ES-33

Accurate forest Cartography	Execution Activities	USAL	N/A	Activity ES-29
Severity map	Execution activities	UdG	N/A	Activity ES-19
Fire risk cartography	COPERNICUS	CARTIF	N/A	Activity ES-16
Fire hazard forecasting	COPERNICUS	NOA	N/A	Activity ES-16
Logistics data (including costs)	Dip Avila FAFCYLE	DipAvila	N/A	Activity ES-28
Firefighting drones fuel consumption	DH	DH	N/A	Activity ES-31
Insurance model and risk transfer solutions	Execution Activities	DTU	N/A	Activity ES-19
Hotspot cartography	Execution Activities	USAL	N/A	Activity ES-30
Fire alarm	Execution Activities	USAL NOA CARTIF	N/A	Activity ES-32
Foam analysis	Execution Activities	BAM	N/A	TBD
Early warning cartography	COPERNICUS	CARTIF	N/A	Activity ES-29
Burning area cartography	COPERNICUS	NOA	N/A	Activity ES-19
Coverage area	Execution activities	8BELLS	N/A	Activity ES-02

Area covered in an operation	Field work Execution activities	DipAvila	N/A	Activity ES-24
Number of interactions ion RRSS	Execution activities	USAL	N/A	Activity ES-29
Number of people achieved	Execution activities	USAL	N/A	Activity ES-29
Historical restoration data	Public databases	UdG Dip of Avila	N/A	Activity ES-07
Historical incidents data	Public Databases	Dip of Avila	N/A	Activity ES-07
Resources of interest in Fire extinction cartography	PLATEA	USAL	N/A	Activity ES-16
Dryness/soil/ fuel/vegetation state cartography	Execution activities	USAL	N/A	Activity ES-16
Drone swarm path report	Execution activities	CERTH	N/A	Activity ES-26

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Table 31: Information on permits required and plan for obtaining these in the Spanish pilot campaign.

Permit	Status/ plan
Flying permits	Will be obtained.

Informed consent	Informed consent from firefighters and possibly from Civil Protection and emergencies. Guidelines given by the TREEADS ethical manager will be followed.

AUSTRIAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

Austria is a country with agricultural and touristic areas in every county. Urban areas are next to recreation areas and agricultural areas. Sometimes, agricultural areas are within the city borders. A special case is Austria's capital city, Vienna. With approx. 2 million inhabitants, this city is one of the biggest forest owners in Austria with 2.200 Ha of forest and agricultural space. The city is also the owner of 60 Ha of vineyards at the outskirts of the suburban quarters.

Most of the forests are used for recreation of the Viennese population. With the Bisamberg and Kahlenberg or Cobenzl, the city has on both sides of the Danube small mountains (450-560m) that allow a wanderlust experience of great pleasure.

As in the recent 40 years, the average rainfall decreased and the soil is partly too dry to absorb rainfall, artificial watering became necessary. In the Marchfeld, the Marchfedlkanal was built in is running at approx. 14km length through the northern parts of Vienna to provide sufficient water supply to the region for agricultural purpose. In total, this artificial channel, built in the late 1990s, has a length of 64km and secures the water supply for a huge agricultural domain in Vienna and Lower Austria.

Still, on the mountains, this artificial water supply is not providing a sufficient support. These forests run dry every year since 2012. Very hard droughts have been in 2012, 2015 and in 2022. As in past times, snow fall during winter times from Dec-Mar. provided a sufficient recovery for the ground water, this is hardly happening anymore, and groundwater is going low. This has also an effect on the mountains and hills, where the smaller vegetation is drying out and parasitic species are affecting the trees to survive. Even as the forests are still healthy, the droughts are putting a harsh pressure towards them.

Additionally, to this, increasing tourism and increasing population in the sub urban areas are putting even more pressure on these regions. The

risk for a wildfire is increasing. The envisaged pilot area is in the district of Floridsdorf, see fact box below.

Floridsdorf, 21st district of Vienna Population: 171.015 inhabitants (2020) Mean population density: 3904/km2 (2020) Mean Age 41y Touristical improving area	SocEco factors: Education: 16.7% academic, 7.95% BHS/HTL(12-14y education and apprenticeship), 9.07% AHS 12-14y education (ends with qualification for University), 11.69% up to 12y education, 29.9% apprenticeship and up to 12y education, 23.76 <9y education Unemployment: 11.56% Annual Netto: 23,220 Eur

Locations planned for use in pilot activities are marked in red in Figure 5.

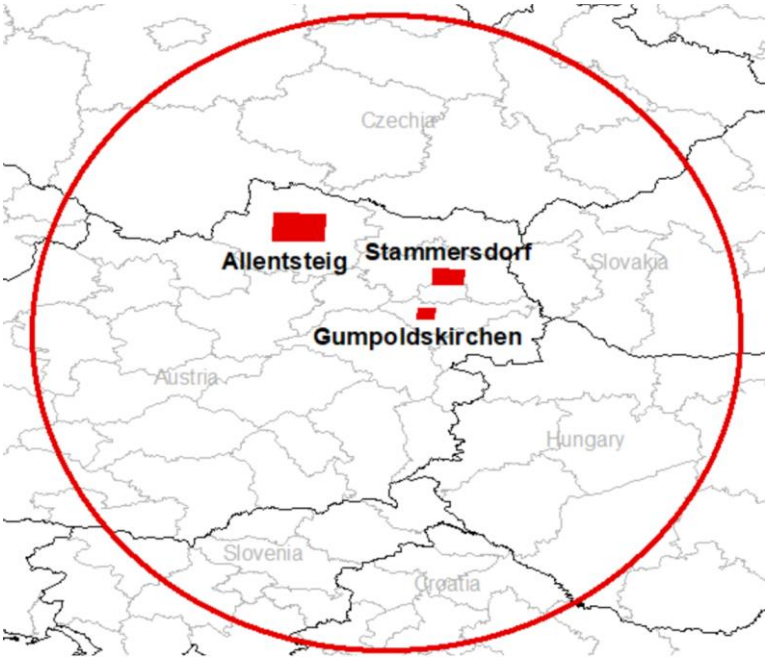


Figure 5: Locations in the Austrian pilot, marked in red.

The pilot scenario is as follows: A fire is breaking out at the Bisamberg. Smoke is pushing towards the highly populated areas of Korneuburg. Evacuation route is through Stammersdorf to secure people as fast as possible and bring them towards the next hospitals in safe areas. All actions of firefigthers and first responders is coordinated through the Area of Stammersdorf. Smoke is also affecting the highway in this region, which means a potential traffic collapse. The scenario is further explained in Figure 6.

Figure 6: Map of the Austrian pilot campaign scenario. Fire start zone marked is by yellow, highly populated area is marked by orange. Wind direction marked by a blue arrow.

To pilot TREEADS, a VR system is provided and a digital representation in VR of Stammersdorf is set up. This can be used for all first responders to train with the TREEADS system and drones and to train evacuation routing and situation awareness.

For a physical pilot, the military training ground Altensteig is available with special permission for drones with the classification of "Special" – which allows the projects drones to be used for real.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the Austrian pilot campaign and the TREEADS consortium are given in Table 32. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 33.

Table 32: TREEADS partners and their roles in the Austrian pilot campaign.

Partner	Role	Short description of responsibilities
JOAFG	Pilot leader	JOAFg is responsible for planning, organizing, coordinate, executing the pilot
FF GPK	First Responder	FF GPK is supporting JOAFG in planning, organizing, and executing the pilot
BFG	Government Support	BFG is providing supporting as counsellor

DCNA	Research Partner	Is supporting JOAFG in planning, organizing, and evaluating the pilot
ACCELI	Technical Partner	Provision of Drones
8BELLS	Technical Partner	AR Helmet technology
Jotne	Technical Partner	TREEADS Servers
DH	Technical Partner	Provision of Drones
CBS	Social partner	Cost-effective suggestions and guidelines based on the pilots' contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
DTU	Associated pilot partner	If applicable, economic assessments of impacts, preventive actions, and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested

Table 33: External participants/ key stakeholders involved in the in the Austrian pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
Vienna Fire Fighters	Support with maps, data and first responders and regional strategies	Meetings, Workshops, Field onsite attendance
Vienna Ambulance Service	Support with maps, data and first responders and regional strategies	Meetings, Workshops, Field onsite attendance
Austrian Ministry of Interior	Data provision	Meetings, Workshops, Field onsite attendance
Austrian Ministry of Defense	Data provision, trial site organization, permissions	Meetings, Workshops, Field onsite attendance

PILOT OBJECTIVES AND KPIS

The objectives of the Austrian pilot target the detection and response phase of wildfires in particular.

Ob.1 Reduction in fire extinguishing time due to better prediction of fire and smoke propagation

Within the scenario, it is important to get in control of the fire situation and especially the smoke development and after the extinction of the primary fire, to keep the hot embers under observation and control. The fire and smoke propagation can help in detecting potential embers and sources of reoccurring fires. The early detection of those sources is reducing the time to get the situation under control.

In a pre-test of the pilot scenario, a basic time for the action will be set by a VR training. The pilot will be compared against this ground data for the scenario.

Ob.2 Reduction in the number of victims

The reduction of victims is the reduction of the impact. A victim is defined here as a person with a medical incident related to smoke, heat radiation and direct contact with flames.

By a pre-analysis of demographic data and inhabitant situation, together with a table-top exercise as preparation for the pilot, a basic number of victims will be announced, and prevention actions will be defined that would reduce this number by trigger/inject in the pilot story. This should allow an estimation of the reduction of victims in the scenario.

Ob.3 Increased personnel safety through smart wearables

The use of smart wearables is especially interesting for fire fighters but also for support units such as medical teams. Vital signs should be monitored by experts with an understanding of the meaning of a change in vital parameters and with a respect to medical limitations of excessive stress. With a monitoring through medical teams, the commander of the situation should be in the position to have an increased security and safety for his people in the field of action. All data will be focused to be represented in the situation room at an expert desk that is linked to S1 and S4 positions. S1 to S4 positions are categories of sound made from heart beats. Monitoring these sounds gives live heart condition.

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In Annex 5, a detailed overview of activities and schedule for the pilot is provided. Here an overview is given.

- Logistic deployment exercises to measure deployment costs and limitations, including flying tests and connectivity tests
- Downgrade risk in area competition to compare supported/unsupported performance considering some indexes (in coordination with municipalities and associations) involves NOA, CARTIF, USAL
- High risk municipality TREEADS preparation: to evaluate deployment costs, accuracy, performance, response times, reach using social networks, etc (in coordination with municipalities) involves all the partners except DTU
- TREEADS detection system vs Traditional protocols (localization accuracy, times) (in coordination with fire brigades in a controlled burning) involves NOA, CARTIF, USAL, ECOSAT, ACCELI
- UAV for fire Extinction exercise (in coordination with fire brigades in a controlled burning) involves DH
- UAV for fire cooldown hotspot detected using UAVs for Thermal Vision exercise (in coordination with fire brigades in a controlled burning) involves DH, ECOSAT, ACCELI, USAL, 8BELLS
- Firefighter's support using TREEADS with 5G helmets connected to a portable communication station against traditional Radio communication exercise (in coordination with fire brigades) involves 8BELLS
- Re-evaluation of already restored areas using goal-driven decision support with different goals and parameters, to evaluate impact and compare results with actual state of the area, including socioeconomic impact. (in coordination with municipalities and associations) Involves UdG, DTU
- Burning areas evaluation to compare technologies (in coordination with municipalities, landowners and postfire brigades) involves UdG

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Austrian pilot campaign is given in Table 34. A more detailed timeline is presented in Annex 5. Table 35 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 34: Overall timeline for the Austrian pilot campaign.

Schedule	Description of activities planned
M13-M19 (AT-1-1 to AT-1-7)	***Field exercises definition***
M20-M26 (AT-2-1 to AT-2-7)	***Logistic and Field exercises preparation*** This activity includes the logistic preparation and coordination of all the activities in the pilot.
M27-M33 (AT-3-1 to AT-3-5)	***Execution part 1*** In this first phase of execution, we will focus on VR exercises in Stammersdorf and the integrated solutions available at hand. With a situation room and communication onsite, we provide the full test scenario. The starting point of the scenario is a call of a hiker that has seen some smoke rising. Following the current SOPs, the scenario will be launched as a table-top exercise and escalate through the steps until a full-scale scenario onsite in VR. A digital representation of the necessary parts in Stammersdorf are going to be run on two different system that are connected within the EXCON. The detection unit will communicate the finding of the fire and the first attack. Fire will spread in the scenario fast and injects will be set to trigger escalation actions. Finally, several fire vehicles and different units are going to be deployed and act together to power the situation room with necessary information and action points. A field team will work in VR on the logistics and spatial order of the mission. From the situation room, drones can be ordered to scan certain areas with IR cameras and to coordinate water strikes against the main fire site. Medical experts will support with the monitoring of vital signs and for the medical support of firefighters and civilians as well as supporting the evacuation. The exercises in this phase will be supported using artificial predefined data and will focus on the activities presented in Annex 5. In this execution part we will try to also work with team volunteers. We will take some measurements: 1) Accuracy of each report, 2) Improvement in recovery times using priorities tool, 3) Improvement in prevention on-field operations times using priorities tools, 4) Fire risk reduction in area after supported on-field operation using TREEADS, 5) Reported data accuracy, 6) Time to obtain the full report for the selected area, 7) Update rates, 8) Number of people achieved using RRSS, 9) Number of interactions using RRSS, 10) End-user (testers) evaluation Surveys.

M27-M33 (AT-4-1 to AT 4-13)	***Execution part 2, including Deployment Logistic tests and Execution part 2 preparation*** *Deployment Logistic tests and preparation:* In the first part of this activity, after logistic preparation, we are dedicated to carrying out deployment exercises that demonstrate the logistical feasibility of a physical deployment of the TREEADS technologies. Involves the participation of technological partners with physical devices (see activity AT-4-1 to AT-4-6 in Annex 5). These activities will help to describe a deployment methodology and obtain values of interest (performance, limitations, times, operational costs). They will also serve to refine the Execution part 2 planification, with the most critical field exercises, especially those related to the use of a Zeppelin and those related to the use of drones for firefighting and hot spot cooling. Integration of the measurements and logistics into the TREEADS platform. Integration of the field measurements into the test methods in *Execution part 2.* *Execution part 2:* The 2nd part of the execution will be run as real-life testing of drones on a military training ground with special permissions. Real fires will be evaluated, and dedicated areas are going to be controlled burned down. The logistic for this exercise are critical and is mandatory to coordinate it with a controlled burning carried out by the fire brigades, so that the preparation exercise is linked to the detection and extinction exercises, to minimize the impact as far as possible. The exercises in this phase will integrate the functionality test, (see activity AT-4-7 to AT-4-11 in Annex 5). This part will also include satisfaction surveys for external participants and public present in this execution exercises, and integration of the results into the TREEADS platform.
M34-M40 (AT-5-1 to AT-5-5)	***Post-processing:*** This task is related to the evaluation of the measures collected in the different executions, the formalization of this data, the creation of a document of suggestions for the support of the decision and the operation based on the evaluation of the execution parts results, and a final section of conclusions, successes and errors, possible improvements, and future work.

Table 35: Activities with dependency on other activities in the Austrian pilot campaign.

Activity	Dependency
Activity AT-1-1 to AT-1-7 depends on the availability of the VR model and the TREEADS elements for the system.	Development delays in the TREEADS system would cause delays in the pilot. Mitigation: Mock-Up Study, Wireframes. A full integration is not needed.
Activity AT (all)	The pilot is chronological, and new each group of activities depends on the previous. That is, the *Post-processing* depends on *Execution part 2*, which depends on *Execution part 1*, which in turn depends on *Logistic and Field exercises preparation* and *Field exercises definition*.

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Table 36: TREEADS technologies used in the Austrian pilot campaign.

Technology	Responsible partner/ Partners involved	Technology will be used in this main activity
HAPs (Zeppelin) for hyperspectral images	ECOSAT	Deployment Logistic tests and Execution part 2 preparation Execution part 2
MCC van for processing linked with HAPs	ECOSAT	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone with Lidar for surveillance and reforest using seed pods	ACCELI	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone for aerial images	ACCELI, UdG	Deployment Logistic tests and Execution part 2 preparation Execution part 2

Drones with LiDAR	ACCELI	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone for firefighting	DH	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Drone for cooldown hotspot	DH	Deployment Logistic tests and Execution part 2 preparation Execution part 2
Accurate forest mapping	USAL	Execution part 2
Fire prevention system	USAL	Execution part 2
Artificial Intelligence for mission planning & swarm coordination	CERTH	Deployment Logistic tests and Execution part 2 preparation Execution part 1and 2

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 37: Plan for data collection and analysis in the Austrian pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Hyperspectral images	ECOSAT Zeppelin,	ECOSAT	N/A	AT-4-1
Zeppelin telemetry	ECOSAT Zeppelin,	ECOSAT	N/A	AT-4-1
Thermal images	ECOSAT Zeppelin, ACCELI Drones, UdG Drones	ECOSAT, ACCELI UdG	N/A	AT-4-1
EO Images	ECOSAT Zeppelin, ACCELI Drones, UdG Drones	ECOSAT, ACCELI UdG	N/A	AT-4-1
LiDAR	ACCELI Drones	ACCELI	N/A	AT-4-1
UAV telemetry	ACCELI Drones UdG Drones DH drones	ACCELI Drones UdG Drones DH drones	N/A	AT-4-1/ AT-4-11
Logistics data (including costs)	Dip Avila FAFCYLE	DipAvila	N/A	AT-2-6/ AT-2-3/
Firefighting drones fuel consumption	DH	DH	N/A	AT-4-1/ AT-4-11
Hotspot cartography	Execution Activities	USAL	N/A	AT-4-11
Fire alarm	Execution Activities	USAL NOA CARTIF	N/A	AT-4-9

Coverage area	Execution activities	8BELLS	N/A	AT-4-8
Area covered in an operation	Field work Execution activities	DipAvila	N/A	AT-1-1/ AT-2-1/ AT-5-1
Drone swarm path report	Execution activities	CERTH	N/A	AT-4-5
Object detection report/cartography	Execution activities	CERTH	N/A	AT-4-8/ AT-4-10/

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

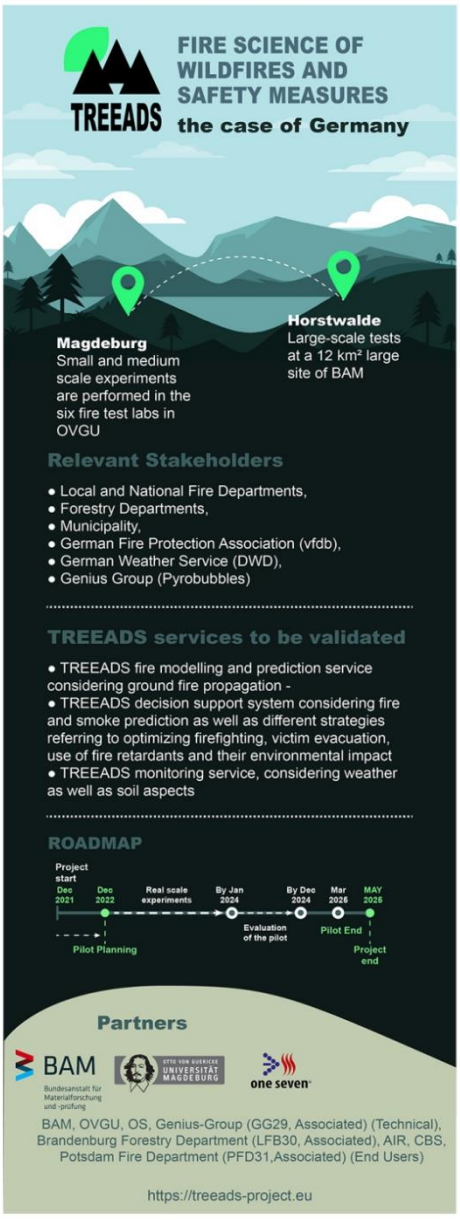
Table 38: Information on permits required and plan for obtaining these in the Austrian pilot campaign.

Permit	Status/ plan
Real Life Pilot on the military ground	All permissions will be obtained through DCNA, this is already on its way
VR pilot	No permissions needed
Informed consent	Informed consent may be required where external partners are participating. Guidelines given by the TREEADS ethical manager will be followed.

GERMAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

One of the overall objectives of the German Pilot is to investigate and test how to manage potentially damaging wildfires in less than 24 hours and how to reduce at least 55% of damaging emissions. Our pilot regions Saxony-Anhalt and Brandenburg are among the German regions with the highest forest fire risk. Vegetation of the common pine (Pinus sylvestris) is affected in 75% of the forest fires in the federal territory. There is an urgent need to characterize the types of fire that occur in relation to vegetation fires as well as to identify significant influencing factors for fire development in these regions.



Research on vegetation and forest fires is intended to close gaps in knowledge about the chemical processes in progress and how the fire starts and spreads, considering climate and topographical influences. For the investigations within the scope of the German pilot project, a numerous series of small-, mid- and real-scale fire tests on material-specific safety-related parameters, fire behaviour and flame spread as well as self-ignition are carried out. Small and mediums scale experiments are the basis to develop a numerical model capable of predicting ignition mechanisms, flame spread, fire propagation as well as smoke dispersion during wildfires using CFD. The real-scale experiments will be used to validate the numerical models. The combination of experiments and numerical investigation allows a quantitative assessment of the influence of the different heat transfer modes and therefore will significantly improve the understanding of fire propagation in these kinds of fires. In addition to that the assessment of environmentally friendly foam agents for fighting wildfires and the application of new extinguish technologies in fire experiments is another important research topic within the German Pilot campaign. Important locations for the German Pilot are shown in Figure 7.

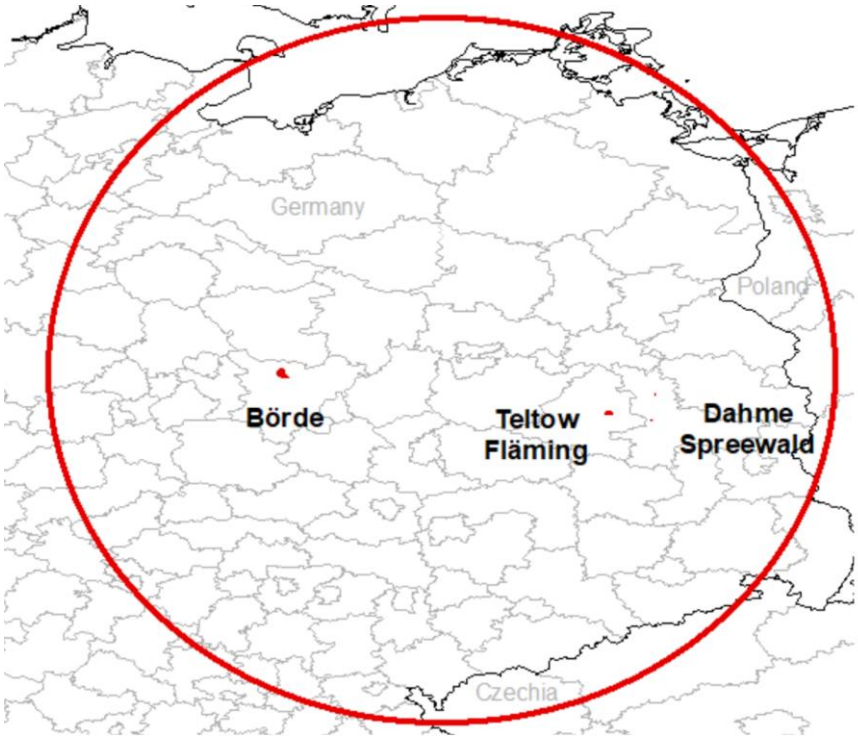


Figure 7: Locations in the German pilot, marked in red.

In summary, the German pilot campaign plan can be summarized as follows:

Step 1: Table-top exercises: includes planning of all activities in the pilot (coordination, surveys, meetings etc.)

Step 2: Small- and mid-scale experiments to characterize fire phenomena and evaluate courses of action for regional forest, fire and population protection

Step 3: Real-scale fire experiments (approx. 4m^2) to elicit fire spread behaviour, emissions, etc. in the experimental area for initial findings, more precise working hypotheses, and safe implementation of the large-scale experiments

Step 4: Ground fires on approx. 50 to 100 m^2 areas with vegetation structures above ground (vegetation close to the ground, trees) to investigate fire dynamics, smoke release and dispersion, environmental influences and the influence of the terrain professional on the areal spread in real scale.

General step: Numerical fire modelling using CFD for the prediction of pyrolysis processes, fire and smoke propagation and evaluation of tenability conditions for the fire brigades, emergency services and the civilian population.

The procedure of the combination of experimental and numerical studies as well as the testing of environmentally friendly extinguishing agents and fluorene free foams in the German Pilot campaign benefit in a better prediction of smoke and fire spread, the control of air pollution and the evaluation of smoke toxicity limits for safe evacuation order as well as health and risk assessment for firefighters, scenario-based concepts for training of tactical units and the environmentally friendly use of compressed air foams.

PARTNERS AND STAKEHOLDERS INVOLVED

The partners which are part of the German pilot campaign and the TREEADS consortium are given in Table 39. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 40.

Table 39: TREEADS partners and their roles in the German pilot campaign.

Partner	Role	Short description of responsibilities
BAM	Pilot Partner	Leader of German Pilot, communication with steering group, large scale experiments in preparation of model area experiments
OVGU	Pilot Partner	Vice leader of German Pilot, responsible for model area of German Pilot in Saxony-Anhalt
OS	Pilot Partner	Pilot Partner, responsible for extinguishment tactics and environmental impact
LAMMC	Associated Partner	Evaluation of fire extinguishing foam effect on tree seedlings
GBD	Associated Partner	Test installation of SCC in burned field sample
Austria-Pilot	Associated Partner	Collaboration between fire services, Data for Machine Learning, Large scale fire tests in sloping site, Test of OS foam
DH	Associated Partner	Test, if Drones can carry extinguishing agents
CERTH	Associated Partner	Building a Digital Twin of German Pilot Area
USAL	Associated Partner	Smoke propagation prediction, Wind field model and fire spread
8BELLS	Associated Partner	Test of AR Helmet and Forest Black Box

CBS	Social partner	Cost-effective suggestions and guidelines based on the pilots' contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities
DTU	Associated pilot partner	If applicable, economic assessments of impacts, preventive actions and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested

Table 40: External participants/ key stakeholders involved in the German pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
vfdb	German Fire Protection Ass., Section 3 Fire service	E, M, W
Wildfire contact DFV	Wildfire contact of German fire service association	E, W
Fire service Cottbus	Fire service in model region Brandenburg	E, W
Pinfa	Phosphorus, inorganic and nitrogen flame retardants ass.	E, W
DWD	German weather ass.	E, W
Forestry office Flechtingen	Forestry in model region Saxony-Anhalt	E, W, M, F
Fire service Ohrekreis	Fire service in model region Saxony-Anhalt	E, W, M, F
District (LK) Börde	Communal administration in model region Saxony-Anhalt	E, W, M, F

District (LK) Flechtingen	Communal administration in model region Saxony-Anhalt	E, W, M, F
Robbi	Drone company	E, W
Polytechnical Institute Wildau	Cooperation on wild fire assessment	E, W
Forestry Brandenburg	Forestry in model region Brandenburg	E, W
Drohnenstaffel LK-Leipzig	DISTRICT OF LEIPZIG Office for fire protection, disaster control and rescue service	E, W, M, F

PILOT OBJECTIVES AND KPIS

The German pilot includes activities related to all the wildfire phases (prevention and preparedness, detection and response, and restoration and adaptation). The objectives and KPI's are described as follows:

- Determine specific ignition characteristics, fire behavior and fire spread of regional vegetation
- Investigate and characterize the smoke gas composition, dispersion of toxic components and the evaluation of smoke toxicity
- Define different limit values for the safety of fire fighters and the civilian population
- Elaborate warning plans for evacuations regarding smoke gases and smoke gas toxicity
- Decrease the number of forest fires and their severity, through a better understanding of ground fire propagation
- Reduce fire extinguishing time due to better prediction of fire and smoke propagation
- Assess environmentally friendly foam agents for fighting wildfires
- Reduction of environmental impact by using innovative fire extinguishing agents as well as firefighting tactics that optimize their use
- Optimize extinguishing technologies / tactics in wildfires experiments
- Development of a basic concept for training, structuring and equipping tactical units
- Optimize firefighting equipment, such as hand nozzles and lances.
- Evaluate the use of spray hoses with CAF for creation of effective barriers by using the hydraulic advantages of foam compared to water

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In Annex 6, a detailed overview of activities and schedule for the pilot is provided. Here an overview is given.

- Perform Large Scale Fire tests
- Measurement campaigns on material-specific safety parameters, on fire behavior and on spread of various types of wildland fire as well as on self-ignition processes
- Experimental Investigations on Smoke Toxicity (e.g., smoldering tests, using portable measurement devices for specific chemical components CO, CO_2) and derivation of
- Development of models and numerical approaches for estimating and predicting wildland fire using Computational Fluid Dynamics
- Creation of tactical approaches to avert danger, differentiating between the different types of vegetation fire occurring in cooperation with associated partners
- Instructions/recommendations for action on forest and wildland fires for Germany in cooperation with European partners and for other European countries
- Evaluation of fire extinguishing foam (concentrates) effect on tree seedlings
- Evaluation of different tactics of firefighting with water and foam
- Evaluation of different nozzles and lances with their effectiveness of firefighting on and in the ground
- Evaluation of the use of spray hoses with foam
- Evaluation and optimization of foam characteristics (e. g. water-air-ratio) for the use on ground and underground wildland fires

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the German pilot campaign is given in Table 41. A more detailed timeline is presented in Annex 6. Table 42 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 41: Overall timeline for the German pilot campaign.

Schedule	Description of activities planned
M7-M19	*Table-top exercises & preparations*: this activity includes planning of all activities in the pilot: Coordination/table-top exercises with fire brigades and other involved stakeholders related to the field exercises in *Execution part 1 and 2*. Survey and evaluation of relevance of test methods for *Execution part 1 and 2*. Survey of relevant background information and relevant guidelines for activity *Post-processing*. Survey of key information related to wildfires in Germany, as input to *Execution part 2* and *Post-processing*. Initial TREEADS cloud-based database server for partners to populate assets, including sensors, and software.
M7-M26	Execution part 1: experimental studies of flame spread, fire behaviour, smoke gas analysis, self-ignition behaviour, flammability and extinguishing tests, flow field investigations in small and bench scale experiments in the BAM and OVGU laboratories
M19-M33	Execution part 2: large-scale outdoor fire experiment in the pilot region Saxony-Anhalt (forest fire investigation) and real-scale fire tests on test site TTS in Horstwalde, BAM Examination of the effects of foam (concentrates) on the growth and development of plants
M19-M41	Post-processing: includes analysis, results and conclusions from fire experiment series in Execution part 1 and 2 and numerical fire simulations (set-up numerical model, physical properties and measured quantities e.g., mass burning rate, temperatures etc.)

Table 42: Activities with dependency on other activities, which could cause delays between activities in the German pilot campaign.

Activities	Dependency
Activity DE-4 to DE-9 depend on Activity DE-2	Small and mid-scale experiments depend on the surveys for these tasks and planning and configuration of the tests
Activity DE-10 to DE-15 depends on Activity DE-3	Real and large-scale experiments depend on the surveys for these tasks and planning and configuration of these tests.
Activity DE-17 depends on Activities DE-4 to DE – 15	Numerical simulation depends on the input of small, mid-scale and large-scale experiments

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Information to be monitored before, during and after fire:

- Fire and smoke propagation
- Weather data on site (temperature, humidity, wind velocity and direction)
- Temperatures on the fire site
- Characteristics of the ground samples (soil, vegetation)
- Smoke toxicity
- Numerical simulation
- Size and development of open flames
- Size and development of amber (hot spots)

Technologies used in the pilot:

- Different measure technologies (thermocouples, infrared camera)
- Portable FT-IR spectrometer
- Weather station system
- Foam generation systems (CAFS) from OS (e. g. demo truck)
- Foam concentrates from OS
- Firefighting equipment from OS
- Cameras/Thermographic cameras on UAV and analysis software
- Fire dynamic simulator (FDS)
- ANSYS suite (CFX, Fluent)
- AR-helmet technology for fire fighters (pending)

Table 43: TREEADS technologies used in the German pilot campaign.

Technology	Responsible partner/ Partners involved	Technology will be used in this main activity
On site measurement equipment	BAM, OVGU	Execution part 1: small scale experiments in labs Execution part 2: Large-scale experiments in central Germany (Saxony Anhalt) and medium scale experiments in Test Site for Technical Safety in Horstwalde (BAM)
Sample measurement equipment	OVGU, BAM	The ground sample from both execution parts will be tested in the lab for the characteristics
Weather station	BAM	Execution part 1: small scale experiments in labs Execution part 2: Large-scale experiments in central Germany (Saxony Anhalt) and medium scale experiments in Test Site for Technical Safety in Horstwalde (BAM)
Numerical simulation	BAM, OVGU	The numerical simulation will be conducted for both large-scale and medium scale experiments
Extinguishing foam	OS, OVGU, LAMMC	Execution part 1: small scale experiments in labs, the extinguishing performance of the foam and further environmental influence Execution part 2: Large-scale experiments in central Germany (Saxony Anhalt) and medium scale experiments in Test Site for Technical Safety in Horstwalde (BAM), test of applying foam with drones; Examination of the effects of foam (concentrates) on the growth and development of plants
AR-helmet technology for fire fighters	8BELLS	Execution part 2: Large-scale experiments in central Germany (Saxony Anhalt)

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 44: Plan for data collection and analysis in the German pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Weather data	National database	DWD	N/A	DE-2
Soil data	Field work	LAMMC	N/A	DE-18
Physical properties of specific vegetation	Lab Experiments	BAM/OVGU	N/A	DE-4 to 7
Flame and smoke propagation, flame spread, smoke gas analysis, temperatures, Fire data	Field work	BAM/OVGU	N/A	DE-4 to 7, 10, 12, 17
Foam and other agents extinguishing data	Lab Experiments Field work	OS/BAM/OVGU	N/A	DE-9, 11, 13, 14, 15
Waldbrand-Atlas	National Database	Bundesamt für Kartographie und Geodäsie	N/A	DE-3
Waldmonitor	National Database	Naturwald Akademie	N/A	DE-3

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

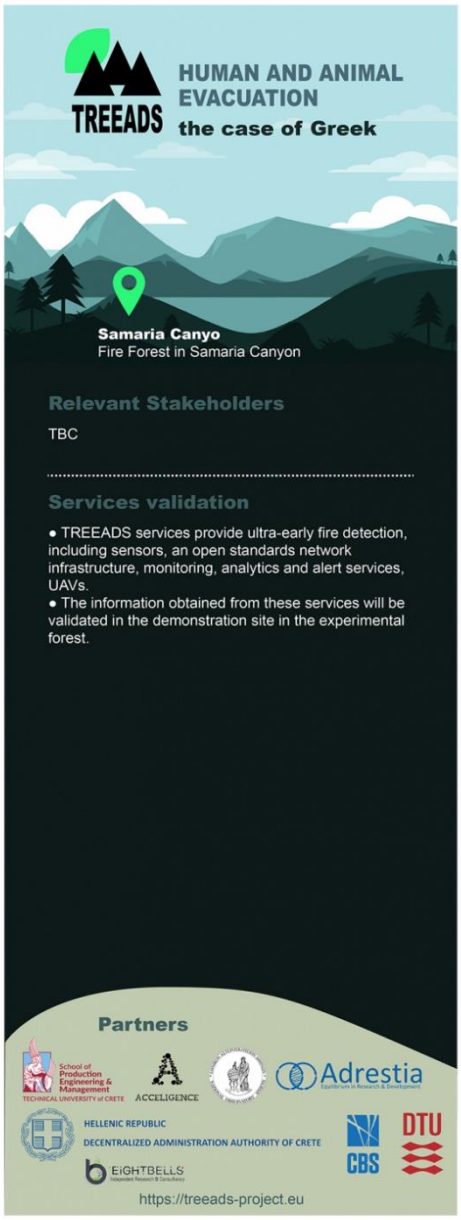
Table 45: Information on permits required and plan for obtaining these in the German pilot campaign.

Permit	Status/ plan
Contract with model region about pilot area fire experiments.	Meetings with responsible persons from model region held on December 12th 2022, identification of exact locations.
Permits for protected areas	No protected areas are used
Informed consent	Informed consent may be required where external partners are participating. Guidelines given by the TREEADS ethical manager will be followed.

GREEK PILOT

BACKGROUND AND PURPOSE OF THE PILOT

Samaria Gorge (hereafter referred to as the Gorge) is located at the southwest of the prefecture of Crete. The Gorge, as well as a wider region around it, has been recognized as a National Park, and belongs in NATURA protected regions. The Gorge is a popular touristic landmark, which can attract a large number of daily visitors ranging from 800 to 2000 per day during the summer season. The Gorge is under the management of the Samaria National Park Management Agency. Additionally, the Forest Directorate of Chania Prefecture currently has several forest rangers located along the path of the gorge. The location of the Samaria Gorge is shown in Figure 8.



The Gorge Is considered to be an area with increased wildfire risk, mainly due to the harsh geomorphology that makes it difficult to evacuate in the case of emergency, the difficulty to detect fire by conventional means, the high number of visitors in the summer months that increase the fire vulnerability, and the usually favourable fire conditions of the South Mediterranean.

There are two natural entrances to access the gorge. The first is located at the Omalos plateau, at Xyloskalo at an elevation of 1227 m. The second entrance, following the path, is located almost 13 Km from Xyloskalo towards the lower end of the gorge, in the village of Agia Roumeli. At Xyloskalo, there exists a department of the fire brigade which is responsible for the timely response in case of a fire event and is in charge of the monitoring and the maintenance of the firefighting equipment. Inside the gorge, there is the abandoned village of Samaria that facilitates the operation of the gorge. The Gorge forms an intermittent river that flows mainly in the winter and spring months. The first kilometers of the path from Xyloskalo exhibit a very steep gradient constructed as a stair-style path. The slope becomes milder towards the exit at Agia Roumeli, yet parts of the path pass through the main riverbed, naturally paved with large cobbles.

Figure 8: Location for the Greek pilot, marked in red.

The pilot storyline will investigate a wildfire outbreak scenario in a difficult location within the Gorge, that makes it challenging to meet standard procedures for fire prevention and preparedness or detection and response. The scenario will test the technological means of TREEADS that will be utilized during the scenario. The technological means to be used include Sensing Infrastructure, Incident Management, Acoustic Sensors, and VR Interfaces. The pilot story and the scenario focus on minimizing the number of victims that could be high in hard to exit terrains. The scenario will highlight the improvements allowed by the project tools with regards to the Sensing and Incident Management Modules, it will evaluate the on-the-field training and demonstrate that TREEADS enhances the protection of S&R squads and their operational capacity. The ultimate goal of the pilot will be to reduce the operation of the command-and-control Center.

PARTNERS AND STAKEHOLDERS INVOLVED

The Table 46 provides an overview of the partners, the role and their responsibility in the Greek Pilot. At this time, the pilot leader (TUC) is in communication with a number of Associated pilot partners/ Technology providers to finalize the list of the technological solutions to be implemented in the Greek pilot. Those partners are mentioned with an asterisk at the bottom of Table 46. The involved partners and stakeholders outside the TREEADS consortium are listed in Table 47.

Table 46: TREEADS partners and their roles in the Greek pilot campaign.

Partner	Role	Short description of responsibilities
8BELLS	Associated pilot partner	Provide AR-helmets for testing with fire fighters in field tests, X/BELLO instant messaging, 5G Communication System, Forest Black Box, AR helmet for Fire Fighters.
ACCELI	Associated pilot partner	ACCELI will be the main UAV technologies provider.
ADRESTIA	Associated pilot partner	Supervision.
CBS	Social partner	Cost-effective suggestions and guidelines based on the pilot's contexts and learnings, ensuring which types of messages can be most effective for a successful Pan-European campaign – CBS will also be supporting the pilot use cases with all the stakeholder activities.
DTU	Associated pilot partner	If applicable, economic assessments of impacts, preventive actions and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested.
FI	Associated pilot partner	A decision support tool for wildfire response.
MAICh	Pilot partner	TUC and MAICh co-leader of the task. Both are responsible for planning, organizing, and executing the field experiments.
NCSRD	Associated pilot partner	Demonstrate and implement Particulate Matter and CO sensors for AR HELMET of 8BELLS, Dispersion modelling of plume in different fire scenarios and crowd evacuation simulations.
NOA	Associated pilot partner	Provide and model climate data for the Greek Pilot Area. Fire danger at high resolution.
OAK A.E.	Stakeholder	Assess the probability of providing additional water resources for fire management.
TUC	Pilot leader	TUC and MAICh co-leader of the task. Both are responsible for planning, organizing, and executing the field experiments.

*USAL	Associated pilot partner	Fire Prevention System, Fire simulations and forest mapping, Hotspot detection, Forest fire spread simulation, Wind field model.
*CARTIF	Associated pilot partner	Earth Observation based toolkit for Fire Exposure and Risk assessment. Territorial assessment tool to evaluate climate related risks and vulnerabilities.
*CERTH	Associated pilot partner	AI for mission planning & swarm coordination. Visual Object Recognition on embedded systems
*SIMAVI	Associated pilot partner	VR Training.
*OVGU	Associated pilot partner	Analysis of Fire Behavior and Spread for the Development of Safety Measures.
*STRESS	Associated pilot partner	Infrastructures fire emergency management strategy.

* Associated pilot partners/ Technology providers where the list of the technological solutions to be implemented in the Greek pilot have not been finalized.

Table 47: External participants/ key stakeholders involved in the Greek pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
Chania Fire Brigade	Responsible for coordination and implementation of detection and response.	E, M, W
Chania Forest Service	Supervision for technologies implementation on the Pilot.	E, M, W
EKAB - National Center For Emergency Chania	On site medical emergency services – Organize training.	E, M, W
Municipality of Chania	Facilitate the coordination of the key actors on the Pilot.	E, M, W

Municipality of Platanias	Facilitate the coordination of the key actors on the Pilot.	E, M, W
NECCA - Samaria Gorge Managers	Major stakeholders, responsible for all the activities performed at the Samaria Gorge.	E, M, W
Neos Omalos - Hotel Managers	Stakeholder. Provide experience on the tourism aspects of the Samaria Gorge.	E, M, W
Terra Petra	Stakeholder. Provide experience on the tourism aspects of the Samaria Gorge.	E, M, W
Police	Stakeholder. To be invited/involved.	E, M, W
Civil protection	Stakeholder. To be invited/involved.	E, M, W
Civil Aviation Service	To be invited/involved – Provide UAV fly licence	E, M, W

PILOT OBJECTIVES AND KPIS

The main objective of Greek pilot targets the deployment of innovative tools that allow to support the two first main phases in a fire, prevention and preparedness and detection and response. Specific objectives that were recognized for the pilot are listed below:

a. Through the pilot scenario to highlight the improvement allowed by the project tools with regards to the Sensing and Incident Management Modules.
b. To evaluate the TREEADS on-the field training, and
c. To demonstrate that TREEADS enhances the protection of S&R squads and their operational capacity.

The above objectives are targeting to the KPIs as proposed by the EC, are listed below:

a. Speed up the information flow among the stakeholder (less than 5 minutes between the command control centres of Gorge management and fire brigade control centres).
b. Allow access to the same information for over 30 users (e.g., fire fighters and forest rangers, coordination team etc.., in the case of a fire).
c. Allow for the classification of the information to the different actors (e.g., commute information to selected targets through the communication channels).
d. Support the creation of a virtual control room within 20 minutes.
e. Support an Incident Management Platform & API with >2 social media & citizens portal.

f. Support a local network for information dissemination among first responders on the field with more than 5 communication interfaces.

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

In Annex 7, a detailed overview of activities and schedule for the pilot is provided. Here an overview is given.

- Activities (GR-04, GR-05, GR-06) are related to objective on "Speed the information flow"
- Activities (GR-04) are related to objective on "Allow access to the same information for over than 30 users".
- Activities (GR-04) are related to objective on "Allow for the classification of the information to the different actors"
- Activities (GR-04) are related to objective on "Support the creation of a virtual control room in 20 minutes".
- Activities (GR-01, GR-02, GR-03, GR-04, GR-05, GR-06) are related to objective on "Support an Incident Management Platform & API with >2 social media & citizens portal"
- Activities (GR-04) are related to objective on "Support a local network for information dissemination among first responders on the field with more than 5 communication interfaces"

The pilot leader will arrange regular meetings with pilot partners (minimum bi-monthly), associated pilot partners (minimum quarterly) and key stakeholders (minimum every 6 months) to discuss the progress towards the objectives. Workshops involving several partners and stakeholders will be arranged when necessary for the progress of the activity (minimum yearly). A stakeholder workshop has been already held in early November 2022.

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Greek pilot campaign is given in Table 48. A more detailed timeline is presented in Annex 7. Table 49 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 48: Overall timeline for the Greek pilot campaign.

Schedule	Description of activities planned
M13-M19	*Table-top exercises & preparations*: this activity includes planning of all activities in the pilot: 1. Coordination/table-top exercises with fire brigades and other involved stakeholders related to the field exercises in *Execution part 1*. Design of field exercises, definition of the scenarios to be implemented. Refinement of the scenarios to be implemented, adjustments to local specifications Definition of use case for each exercise, including sequence Diagrams for each use case/exercise. Final selection of field exercises and execution commitment through the definition of roles for each partner per exercise. 2. Selection of the most representative location(s) to perform the exercises of *Execution part 1* and the large-scale deployment of the technologies in an integrated exercise. 3. Survey and evaluation of relevance of test methods for *Execution part 2*. Survey of relevant background information and relevant guidelines.
M13-M38	*Execution part 1*: Field exercises in Greek pilot. Test of the provided technologies on site with the active involvement of the technological partners, to identify strengths and weaknesses and suggest the related adjustments to maximize the technological benefits related to the KPIs. *Execution part 2.* Integration of relevant findings in the scenario field exercise on the pilot. Use of the TREEADS server in field exercises. Run the pilot demo with stepwise implementation of all the available technological solutions. Assessment of the KPIs and the value added by TREEADS.
M26-M40	*Post-processing:* Summarize the findings related to the pilot scenarios runs. Collection of information and measurements of the exercises of the different executions. Evaluation of costs/benefits for each technology in the different phases of a forest fire (prevention, preparation, detection, response). Summary table of operation costs of each tool in logistical terms based on the execution costs. Provide suggestions and guidelines for evacuation of the Gorge in the case of a wildfire. In this activity, input will be taken from *Table-top exercises & preparations,* from *Execution part 1* and from *Execution part 2.*

Table 49: Activities with dependency on other activities in the Greek pilot campaign.

Activities	Dependency
Activity GR-01 depends on Activity in WP4	The Fire Danger Index is a mature product developed in the framework of WP4 - T4.1 by NOA. There are no expected delays in the implementation to the Greek Pilot.
Activity GR-02 depends on Activity in WP5	Hotspot detection systems involve UAVs that are being developed in the framework of WP5 – T5.3 and T5.5 from ACCELI. Any delays may affect the Execution part 1 and 2.
Activity GR-03 depends on Activity in WP5	AR helmets that will aid the firefighters are to be developed within the framework of WP5 – T5.4 by 8BELLS. Any delays may affect the Execution part 1 and 2.
Activity GR-04 depends on Activity in WP4	A secure incident-management toolset for decision making and communication to all respective stakeholders on Samaria is to be developed within WP4-T4 by 8BELLS. Any delays may affect the Execution part 1 and 2.
Activity GR-05 depends on Activity in WP5	Hotspot detection will be aided by Visual object recognition technology that is to be developed within WP5 -T5.1 by 8BELLS. Any delays may affect the Execution part 1 and 2.
Activity GR-06 depends on Activity in WP5	A resilient and smart framework for event-driven and context-aware fire detection is to be developed in WP5-T5.7 by USAL. Any delays may affect the Execution part 1 and 2.
Activity GR-07 depends on Activity in WP5	CO and PM sensors will be implemented on the AR Helmet of GR-03 activity. Also, a plume dispersion model will be implemented for different scenarios for the Pilot (T4.2).

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Table 50: TREEADS technologies used in the Greek pilot campaign.

Technology	Responsible partner, Partners involved	Technology will be used in this main activity
AR-helmet technology for fire fighters	8BELLS	Table-top exercises & preparations Execution part 1: Field exercises in Samaria Gorge. Execution part 2 (medium/large scale experiment).
Low altitude UAV Mission drones	ACCELI	Execution part 1: Field exercises in Samaria Gorge. Execution part 2 (medium/large scale experiments).
Sensors (IR – CO_2)	8BELLS	Table-top exercises & preparations Execution part 2 (medium/large scale experiments).
5G Portable Communication System	8BELLS	Table-top exercises & preparations Execution part 2 (medium/large scale experiments).
X/BELLO instant messaging	8BELLS	Table-top exercises & preparations Execution part 2 (medium/large scale experiments).
Fire danger index	NOA	Table-top exercises & preparations Execution part 1: Field exercises in Samaria Gorge. Execution part 2 (medium/large scale experiments).
PMs and CO sensors on AR helmets	NCSRD	Table-top exercises & preparations Execution part 2 (medium/large scale experiments).

Plume dispersion	NCSRD	Table-top exercises & preparations Execution part 1: Field exercises in Samaria Gorge.

PLAN FOR DATA COLLECTION AND ANALYSIS

There are meteorological stations available in the pilot site, providing temperature, humidity, and air pressure data. These are available by the project partner NOA. TUC will facilitate any potential exchange requested by any other partner. To this time there is no such request.

Table 51: Plan for data collection and analysis in the Greek pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Weather data	NOA owned weather stations and databases	NOA	N/A	Activity GR-01
CO measurements	NCSRD	NCSRD	To be provided to 8BELLS	Activity GR-03
CO2 measurements	8 BELLS	8 BELLS	N/A	Activity GR-05
IR measurements	ACCELI	ACCELI	N/A	Activity GR-02

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Table 52: Information on permits required and plan for obtaining these in the Greek pilot campaign.

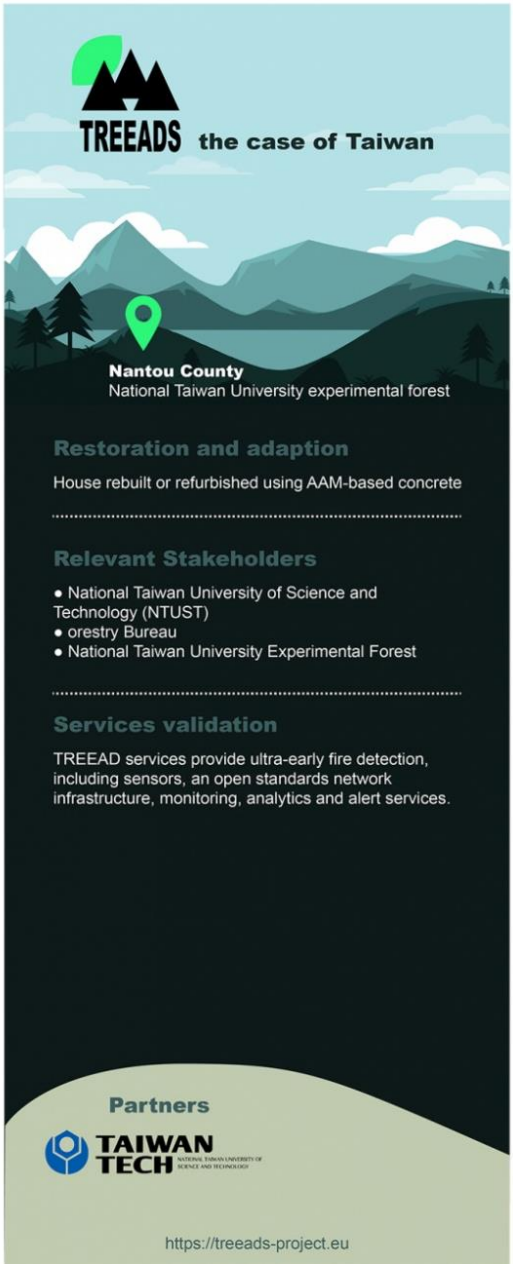
Permit	Status/ plan
Permit for flying UAVs over the pilot region	Pilot leader will grant the potentially necessary permits to fly UAVs over the study region.
Potential 5G transmission permit	Pilot leader will grant a potentially necessary permit for 5G transmission in the pilot area.
Handling of personal information/ other sensitive data	The project will use the TREEADS data management plan and appointed data protection officer at each partner organization.
Informed consent	Informed consent may be required where external partners are participating. Guidelines given by the TREEADS ethical manager will be followed.

TAIWAN PILOT

BACKGROUND AND PURPOSE OF THE PILOT

According to the Taiwan forestry statistics, forest wildfires mostly occurred between January and April, typically caused by human activities. The fact is that Taiwan lies in the tropics and the climate is therefore classified as marine tropical. Compared to the other seasons, spring has the relatively drier weather condition. There have been little incidents occurred due to seasonal wildfires.

Statistical data on forest wildfires revealed that 50 fire alarms and 30 wildfires incidents in average every year. The damaged areas reached around 650 ha, and monetary damages were estimated approximately 3 million euros. The historical wildfire incidents including the Yushan Tataka fire in 1993, the Lishan fire in 2002, the Yushan Dongfeng fire in 2002, and the Wuling fire in 2003, were all massive forest wildfires. These incidents made a deep impression on people. It appears that 99.6 percent of forest fires are caused by human factors. The fact that 49 percent of arsonists who perpetrate fires are never discovered is regrettable. Human caused fires can be attributed to agricultural burning, discarding lit cigarette butts, building fires for warmth and light (camping activities), and burning of joss paper.



Nevertheless, in Taiwan, wildfire prevention, detection and response still rely on traditional ways such as: reporting from civilians or CCTV monitoring in some stations. In the event of a wildfire, the incidents were routinely reported to the local authorities and fire bureaus in order for extinguishing the forest wildfire. However, difficulty is encountered with approaching mountainous terrains when the wildfire occasionally occurs. As a result, it takes time to reach the wildfire area. A holistic fire management ecosystem like TREEADS can be seen as a solution in preparation, protection, management and restoration for the forestry.

The location of the Taiwan pilot will be determined in M12-M15. The most promising area is shown in Figure 9.

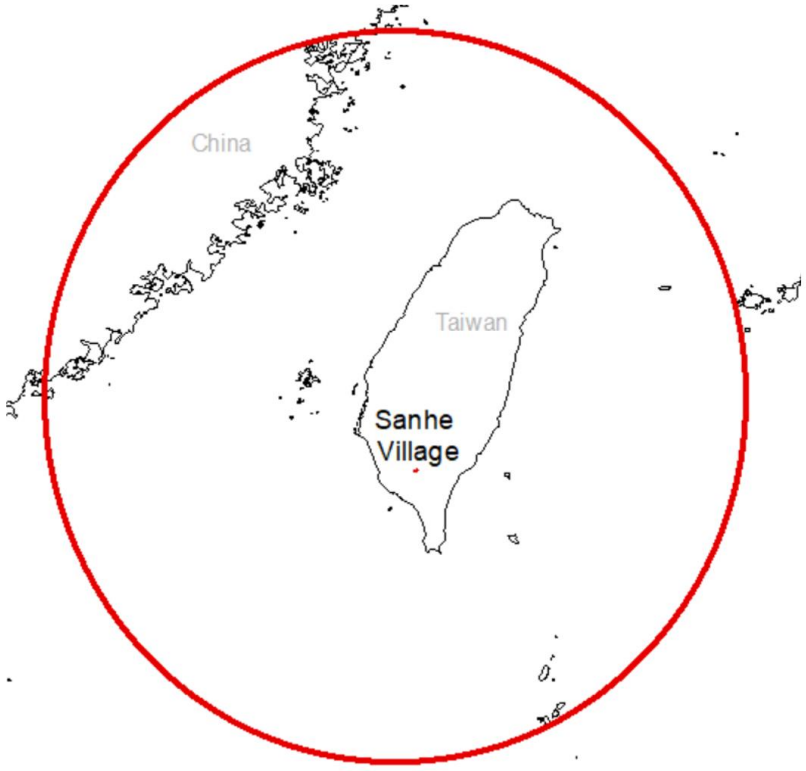


Figure 9: Tentative location of the Taiwan pilot, marked in red.

PARTNERS AND STAKEHOLDERS INVOLVED

The most actively involved partners in the Taiwan pilot campaign are given in Table 53. Of these, only NTUST, CBS and DTU are part of the TREEADS consortium. Other external partners and stakeholders outside the TREEADS consortium are listed in Table 54.

Table 53: TREEADS partners and other central partners in the Taiwan pilot campaign, and their roles.

Partner	Role	Short description of responsibilities
NTUST	Pilot leader	The task is being carried out under the direction of NTUST. The field and laboratory experiments will be planned, organized, and carried out by NTUST.

CBS	Associated partner	Available to support the pilot with cost-effective suggestions and guidelines based on the pilot's context and learnings, ensuring which types of messages can be most effective for a successful campaign - CBS can also support the pilot use cases with all the stakeholder activities
DTU	Associated partner	If applicable, economic assessments of impacts, preventive actions and restoration solutions. Where relevant, insurance and (economic) risk transfer solutions will be suggested
NTUT	Partner	Study and develop IoT network and weather box device for weather and fire observation.
TFRI	Partner	Study and provide the fire and smoke spread simulation model
NKUST	Partner	Supporting work related to using wood ash in construction materials
Forest owner	Partner	Provide the wood ash from the timber factory and pilot location

Table 54: External participants/ key stakeholders involved in the Taiwan pilot campaign, and planned communication methods (Email, Meetings, Workshops, Surveys, Field on-site attendance, Lab on-site attendance).

Participant	Short description of expected contribution	Communication method
TFRI- council of Agriculture	Provide the supporting letter	E, M, W
National fire agency	Provide the supporting letter	E, M
Chien Chung Construction Co., Ltd	Civil Infrastructure Material Supplier	E

PILOT OBJECTIVES AND KPIS

These are the objectives of the Taiwan pilot:

- Produce excellent fire resistance concrete using wood ash based on alkali-activated materials method and cement partial replacement and then apply the concrete to produce the hollow brick for Pilot case
- Build up the fire detection and weather conditions monitoring system using the IoT network and LoRa advance technique device that is used for the fire warning system
- Study and develop a fire and smoke spread simulation model used for the fire warning system

The KPIs of Taiwan pilot are listed as below:

- 5% coverage rate of the monitoring stations using IoT system with low-power supply in the country.
- 30% Recycled rate and the use of post-wild fire wood ashes in construction materials
- 10% reduction in strength of concrete when experiencing high-temperature conditions

ACTIVITIES IN THE PILOT AND HOW THESE RELATE TO THE OBJECTIVES AND KPIS

The Pilot leader arranged the meeting with pilot partners and stakeholders at least 3 months per time and the workshops will be held to discuss the progress of project activity at least 1 time per year. The activities of Taiwan Pilot are mainly linked to the prevention and preparedness phase and the detection and response phase of wildfires, and are summarized as below:

Part 1: Fire resistance concrete produced with wood ash which is related to the KPIs of using Wood ash up to 30% in concrete production with 10% reduction in strength of concrete when experiencing high-temperature conditions

- Activities (TW-01, 03) are related to objective on "characterizing of alkali-activated material paste using wood ash and other by-products (ground granulated blast furnace slag and fly ash)". The result will be supported to fire resistance concrete material using wood ash.
- Activities (TW-01, 03) are related to objective on "characterizing of cement paste using wood ash as cement partial replacement". The result will be supported to fire resistance concrete material using wood ash.

Part 2: Using the weather box and IoT network for a fire warning system which related to the KPIs of 5% coverage rate of the monitoring stations using IoT system with low-power supply in the country

- Activities (TW-07) are related to objective on "determine the concrete properties using the non-destructive test". The result will be supported to fire resistance concrete material using wood ash.
- Activities (TW-04, 06, 07) are related to objective on "determine the weather condition using weather box and IoT network which is related to the fire warning system".
- Activities (TW-05, 07) are related to objective on "simulate the spread of fire and smoke model which is related to the fire warning system".

TIMELINE AND INTERDEPENDENCY OF PLANNED ACTIVITIES

The overall timeline for the Taiwan pilot campaign is given in Table 55. A more detailed timeline is presented in Annex 8. Table 56 describes dependencies between activities, such as where a delay in one activity would cause a delay in another activity.

Table 55: Overall timeline for the Taiwan pilot campaign.

Schedule	Description of activities planned
M01-M18	Produce the AAM concrete and cement paste concrete with wood ash
M12-M15	Determine the pilot location
M15-M24	Produce the hollow brick from concrete and build up the pilot case
M12-M24	Build up the fire detection and weather conditions monitoring system and IoT network and then trial test in the laboratory
M15-M24	Develop the fire and smoke spread simulation model
M24-M30	Attach the weather box to the pilot case
M30-M42	Collect data and prepare the report

Table 56: Activities with dependency on other activities in the Taiwan pilot campaign.

Activity	Dependency
Activity TW-3	Depends on Activity TW-1
Activity TW-6	Depends on Activity TW-2, TW-3
Activity TW-7	Depends on Activity TW-6

TECHNOLOGIES TO BE USED IN THE PLANNED ACTIVITIES

Information to be monitored before, during and after the fire at the pilot case:

- Temperatures
- Humidity
- Smoke concentration
- Fire intensity: energy released during various phases of a fire
- Fire spread direction
- Strength of concrete samples

Technologies used in the pilot:

- AAM concrete
- Weather box system
- IoT network

Table 57: TREEADS technologies used in the Taiwan pilot campaign.

Technology	Responsible partner/ Partners involved	Technology will be used in this main activity
AAM concrete	NTUST, NKUST	Execution part 1: Experimental work in laboratory. Execution part 2 (medium/large scale experiments).
Cement paste concrete	NTUST, NKUST	Execution part 1: Experimental work in laboratory. Execution part 2 (medium/large scale experiments).
IoT network	NTUT	Execution part 1: Experimental work in laboratory. Execution part 2 (medium/large scale experiments).
Weather box	NTUT	Execution part 1: Experimental work in laboratory. Execution part 2 (medium/large scale experiments).
Fire and smoke simulation model	TFRI	Execution part 1: Experimental work in laboratory. Execution part 2: using the Data record from Pilot for the simulation

PLAN FOR DATA COLLECTION AND ANALYSIS

Table 58: Plan for data collection and analysis in the Taiwan pilot campaign.

Data type	Data source	Responsible	Analysis plan*	Activity
Concrete characteristic	Laboratory experiments	NTUST, NKUST	N/A	TW-1
Fire properties of concrete	Laboratory experiments	NTUST, NKUST	N/A	TW-1
Weather data	Field work	NTUST, NTUT	N/A	TW-4,6,7
IoT network	Laboratory experiments	NTUT	N/A	TW-4
Simulation model	Field work	TFRI	N/A	TW-5,7

* E.g., explanation of model to which the data will be input

OTHER FEATURES OF THE PILOTS RELEVANT FOR PERMITS

Table 59: Information on permits required and plan for obtaining these in the Taiwan pilot campaign.

Permit	Status/ plan
Permit for install the Taiwan Pilot case in the forest location	Pending permission from the Forestry bureau
Permit for burning of forests in Taiwan Pilot location	Pending permission from the Forestry bureau
Informed consent	Informed consent may be required where external partners are participating. Guidelines given by the TREEADS ethical manager will be followed.

CONCLUSIONS AND IMPLICATIONS

The EU-funded project TREEADS aims to develop and integrate technologies in a holistic wildfire management platform. The TREEADS pilot campaigns will demonstrate the socio-technological solutions created for the holistic wildfire management platform. The focus areas of each pilot campaign are as follows:

- The Norwegian pilot campaign focuses on wildfires in Northern Europe and passive fire protection for buildings and infrastructure. The focus is on prevention and preparedness for wildland-urban-interface fires, as well as fire service's logistics both for prevention and for detection and response.
- The Italian pilot campaign focuses on fire emergency management strategy for a cable car system in the Sorrento Peninsula. In addition to detection and response, the pilot will also consider eco-sustainable construction materials as part of the TREEADS prevention and preparedness work.
- The Romanian pilot campaign focuses on wildfire in a National Park and will demonstrate the use of AR-VR technology in training exercises for firefighters. The pilot campaign is connected to wildfire phases prevention and preparedness, and detection and response.
- The Spanish pilot campaign focuses on deployment of innovative tools that support wildfire management in all three main phases of Wildfires: prevention and preparedness, detection and response, and restoration and adaptation. The demonstration will take place in a high-risk zone for wildfires.
- The Austrian pilot campaign focuses on peri-urban wildfires. The technologies that will be demonstrated are mainly connected to detection and response, such as VR technology and drones for surveillance and firefighting.
- The German pilot campaign focuses on fire science of wildfires and safety measures, and restoration of burned areas. There are activities related to all three wildfire phases.
- The Greek pilot campaign focuses on improved wildfire management through tools that support the pre-fire management, i.e., prevention and preparedness, and the detection and response during a wildfire.
- The Taiwan pilot campaign has its focus on technologies for wildfire prevention and preparedness, and the detection and response during a wildfire. The pilot will test fire-resistant concrete developed in the TREEADS project, develop a detection and weather conditions monitoring system and develop a fire and smoke spread simulation model used for the fire warning system.

In this deliverable, a framework for the TREEADS pilot campaign plans and for the pilot evaluation methodology has been presented. Each pilot campaign has been presented with detailed information on the background and purpose of the pilot, partners and stakeholders involved, objectives and KPIs, activities in the pilot, timeline, the technologies used, and details on data collection and permits needed.

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ANNEX 1: NORWEGIAN PILOT TASK 8.2

NORWEGIAN PILOT DEFINED BY ACTIVITIES

Activity	Definition of activity	Schedule (start-end)
	Table-top exercises & preparations	**M13-M19**
NO – 01	Coordination/table-top exercises with fire brigades and other involved stakeholders related to the field exercises in Execution part 1 (FRN).	M13-M19
NO – 02	Survey of key information related to wildfires in Norway, as input to Execution part 2 and Post-processing (FRN).	M15
NO – 03	Survey and evaluation of relevance of test methods for Execution part 2 (FRN).	M15
NO – 04	Survey of relevant background information and relevant guidelines for activity Post-processing (FRN).	M15
NO – 05	Survey of available technologies for PFP materials and market potential for protection of steel and concrete infrastructure onshore (VIPO).	M17
NO – 06	From Task 4.7 – Development of materials used in product for PFP protection of steel and concrete infrastructure onshore (VIPO). - Selection on the possibility to use materials based on alternative polymers - Selection on the possibility of implementation of new additives and fillers - Selection on the possibility of improving mechanical properties and robustness of PFP materials	M19
NO – 07	Development of product used as PFP protection of steel and concrete infrastructure onshore (VIPO). Activity is closely connected with task NO-06. - Selection of parameters to study for a simpler product solution - Selection of parameters to study for a more light-weight product solution	M19

	- Selection of parameters to study for a cheaper product solution	
NO - 08	From Task 4-7 - Establish on-site set up for material screening small-scale fire tests for use during development of new material concepts (VIPO)	M19
NO – 09	Survey and evaluation of existing test methods internationally for classification of wooden surface materials (WAS). - Collection of data from previous forest fires (EU, AUS & US) - Identify relevant testing range - Evaluate current fire test methods and standards (EU, AUS & US) - Propose amendments if appropriate / needed	M19
NO – 10	From Task 4.7 – Development of materials used in product for improved fire resilience of wooden cladding for buildings (WAS). - Study existing data sets from own library as well as data provided by other partners (Woodsafe and Woodsafe allies) of fire tests deemed relevant to acquiring knowledge that will assist us in setting a quality assured fire testing schedule. - The study will focus on the differences between wood species, wood thickness, the use of surface coating systems, impregnation type and more.	M19
NO – 11	Development of product used for improved fire resilience of wooden cladding for buildings (WAS) - Selection of focus areas and specifications needed for improved fire properties, economy, environmental aspects	M19
NO – 12	Create initial standard solution for improved rescue logistics (Jotne) - Holistic system based on the open standard ISO 10303 - Using information gathered from the fire brigade Specific sensors and data sources to be decided based on interviews with fire brigade	M19
NO – 13	Develop an initial repository for Norwegian Wildland fires (Jotne)	M19

	- The TREEADS repository will include data from sensors and equipment from FRN/RISE Create initial improved asset information system for pilot partners (Jotne) - Database will contain all assets that the partners will be bringing into the pilot - From task 7.1 and 7.3, database created from the inventory list o Will also be offered to other pilots	
	Execution part 1: Field exercises in Norwegian forest and costal land.	**M13-M38**
NO – 14	Field exercises in Norwegian forest and costal land, performed during Norwegian spring seasons (FRN, Jotne). Overall plan for field exercises: M16: Main field exercise: One or more field exercises in forest and in heather/grassland. Key input to Execution part 2 since the first field exercises will be most important for test development, based on measurements of flame propagation speed, temperatures, heat flux, soil samples (pending). Backup input to postprocessing: input to guidelines. M28: Main field exercise: One or more field exercises in forest and in heather/grassland. Key input to Postprocessing: Input to guidelines. Backup input to execution part 2 on test method development. M40: Backup field exercise: Backup input option for Postprocessing: input to guidelines.	M16, M28, M40
NO – 15	Integrating the field measurements into the test methods in *Execution part 2* (FRN).	M24, M33
NO – 16	Streamlining of logistical processes related to firefighting efforts of wildfires (Jotne).	M16, M28, M40
NO – 17	Integrating the measurements and logistics into the TREEADS platform (Jotne /FRN).	M38
NO – 18	Integration of relevant findings in the field exercises into the guidelines work in *Post-processing* (FRN/ Jotne /CBS).	M18, M30
NO – 19	Use of the developed TREEADS server to offer improved rescue logistics, and asset information (Jotne)	M38

NO – 20	Use of foam extinguishing-product to protect buildings and infrastructure from fire spread as part of the field exercises (OS). (pending, dependent on whether relevant for Norwegian fire brigades)	M16, M28, M40
NO – 21	Integrating augmented reality (AR) technology for firefighter helmets in field exercises in Norwegian forest and costal land, performed during Norwegian spring seasons (8BELLS). (pending)	M13-M38
Execution part 2: Development and execution of a controlled and realistic test method		**M18-M38**
NO – 22	Development of realistic test methods relevant for wildland fires (based on input from *Table-top exercises* & preparations and from *Execution part 1*) in different scales. Focus will be on reaction to fire testing methods. For the large scale method, known façade testing methods and known wildland exposure methods will be considered and adapted.	M18-M24 M28-M33
NO – 23	Development of materials (T4.7) and products used as PFP protection of steel and concrete infrastructure onshore (VIPO). - Material development - Development is a part of T4.7, and gives input to T8.2 - Materials ready for small- or medium scale fire experiments: first round M13, second round M25, third round M32. - Product development - Development of products will be based on material development in T4.7. - Evaluation of products with lab experiments based on input from *Table-top exercises* & preparations and from *Execution part 1.* - Studying parameters for a simpler product solution. - Studying parameters for a more light-weight product solution. - Studying parameters for a cheaper product solution. - Products ready for large scale fire experiments: M33	M13, M25, M32, M33

NO - 24	Development of product used for improved fire resilience of wooden cladding for buildings (T4.7) and demonstration of the fire resilient properties (WAS) - Product development - Study differences between wood species (reaction to fire performance indicators, cost implications – density and impregnation saturation, and wood-thickness) - Study implication of using various surface coating systems (non-fire solutions, standard systems only) - Study using both types of Woodsafe impregnation products (PRO, Exterior WFX) to identify the most cost effective and durable solutions - Identifying one or more solutions that will qualify within the desired set of parameters for fire in combination with durability, sustainability and cost efficiency for large scale testing and commercialising. - Products ready for small- scale fire experiments (T4.7): first round M15, second round M25 - Products ready for large-scale fire experiments: M33 - Products ready for medium-scale classification experiments using the SBI method: M33	M15, M25, M33
NO – 25	Execution of experiments to document and evaluate the reaction to fire properties and performance of the fire resilient materials and products (FRN/WAS/VIPO) - Small and medium scale experiments (part of T4.7): M13, M15, M25 and M32 - Medium scale classification tests: M33 - Large scale experiments: M34-M36 Output from this activity will give input to the guideline development in *Post-processing*.	M13, M15, M25, M32, M33, M34-36
NO – 26	Integrating the experimental results into the TREEADS platform (Jotne/FRN).	M15-M38
NO – 27	Deploy the TREEADS server to archive test data (Jotne)	M15-M38
Post-processing: Development of cost-effective methods to protect key infrastructure and residential buildings		**M26-M40**

NO – 28	Summarize the findings related to the development of cost-effective methods to protect steel and concrete infrastructure in areas with a high risk of wildland fires (VIPO/FRN). - Re-evaluation of the tested materials and products with input from the lab tests (VIPO) - Summarize findings related to simpler, light-weight, cheaper materials and products (VIPO)	M26-M40
NO - 29	Summarize the findings related to the development of improved fire resilience of wooden cladding for buildings in areas with a high risk of wildland fires (WAS/FRN). - Re-evaluation of the tested materials and products with input from the lab tests (WAS) - Summarize findings related to improved fire properties, economy, environmental aspects (WAS) - Qualified test combinations will be re-evaluated and results confirmed before CE-certification - Evaluate qualified combinations to tested for EN 16755 (durability) - Summarize findings related to relevant test methods for improved fire resilience of wooden cladding for buildings, relevant for wooden construction in areas with a wildfire risk (WAS/FRN)	M26-M40
NO – 30	Provide suggestions and guidelines for safety zones and WUI areas based on Norwegian conditions (FRN/ Jotne /CBS).	M26-M40
NO – 31	Provide suggestions and guidelines for building technical requirements for wooden buildings in areas with a high risk of wildland fire (FRN/ Jotne /CBS/WAS/VIPO).	M26-M40
NO – 32	Finalize the work on streamlining rescue and logistics processes. In this activity, input will be taken from *Table-top exercises* & preparations, from Execution part 1 and from *Execution part 2*.	M26-M40

ANNEX 2: ITALIAN PILOT TASK 8.3

ITALIAN PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
	Table-top exercises & preparations	
IT - 1	Coordination of overall Pilot Actions involving all the Pilot stakeholders and related to the different objectives (ALL): 1. Validation of an innovative Infrastructures Fire Emergency Management Strategy applied to the design of a Cable-Car System in the Sorrento Peninsula 2. Validation of eco-sustainable construction materials with increased fire performances developed in T4.7 3. Fire detection and Response simulation in real environment 4. Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires	M13-M19
IT - 2	Survey on existing information and Collection of data for the different operational scenarios (ALL).	M15
IT - 3	Survey of relevant background information and relevant guidelines for activity Post-processing (STRESS).	M19
IT - 4	Upgrade and customization of USAL modelling tools for their integration in the Infrastructures Fire Emergency Management Strategy (USAL).	M19
	Execution part 1: Infrastructures Fire Emergency Management Strategy.	**M20-M40**
IT - 5	Simulation of forest fires in the Sorrento Peninsula (STRESS, TECNOSISTEM, ACaMIR, USAL)	M20-M26

IT - 6	Optimization of cable car layout (TECNOSISTEM, ACaMIR)	M20-M26
IT - 7	Analysis of temperature field on structural parts and main systems of cable car (TECNOSISTEM, ACaMIR)	M27-M33
IT - 8	Analysis of smoke and toxic species diffusion on cable car (TECNOSISTEM, ACaMIR)	M27-M33
IT – 9	Analysis of passenger evacuation, evaluation of liveability parameters during fire emergency. (TECNOSISTEM, ACaMIR, NCRSD)	M34-M38
IT – 10	Evaluation of innovative mitigation measures and safety systems	M34-M38
IT – 11	Guideline development for the overall Infrastructures Fire Emergency Management Strategy	M39-M40
	Execution part 2: Validation of eco-sustainable construction materials with increased fire performances (T4.7) (RINA, UNINA)	**M20-M40**
IT – 12	Manufacturing of concrete and AAM samples: • Physical and mechanical characteristation at fresh and hardened condition of concrete and AAM samples • Data analysis	M20-M23
IT – 13	Mix design optimisation and selection of the best perfoming mixes: • Physical and mechanical characteristation at fresh and hardened condition of best performing mixes • Fire resistance tests • Durability tests	M20-M33
IT – 14	Building elements or materials (e.g. blocks, plasters) manufacturing	M29-M31

IT – 15	Recommendation for end-users	M31-M33
IT – 16	Mapping of possible areas of application of Nature-based and fire-resilient solution for restoration	M34-M38
IT – 17	Operative suggestions and Guidelines to be proposed to local actors (Sorrento Municipality, Campania Region Civil Protection, VVFF- Regional Fire Fighters Service in Campania)	M36-M40
	Execution part 3: Fire detection and Response simulation in real environment	**M20-M40**
IT – 18	Planning of simulation actions in real environment (STRESS, Sorrento)	M20-M26
IT – 19	Creation of rules related to the possible situations will be created starting from the Regional Plan for Prediction, Prevention and Active Fight to Forest Wildfires. CEP system (FI, STRESS, Sorrento)	M27-M33
IT – 20	A virtual Model of a specific area will be provided to support VR simulation of various operations (SIMAVI, STRESS, Sorrento).	M27-M33
IT – 21	On field operations simulation: • Based on the previously calculated fire propagation scenarios (USAL), an alert input will be fed to the CEP system (FI, STRESS, Sorrento). • The CEP system provides input to WRE that activates specific alerts or sends specific recommendations to the various actors: First Responders, Citizens, Authorities. (FI, STRESS, Sorrento) • On field operations will be simulated using the previously described tools and with the direct involvement of specific trained personnel (PUI, STRESS, Sorrento).	M34-M40
	Execution part 4: Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires	**M20-M40**

IT – 22	Preventive risk analysis for wildfires in protected forest areas (DTU, CBS, STRESS, Sorrento)	M20-M26
IT – 23	Identification of possible Risk Transfer solutions (DTU, CBS, STRESS, Sorrento)	M27-M33
IT – 24	Cost-Benefit analysis on possible preventive actions (DTU, CBS, STRESS, Sorrento)	M27-M33
IT – 25	Analysis of possible economic restoration solutions after forest fires (DTU, CBS, STRESS, Sorrento)	M34-M40

ANNEX 3: ROMANIAN PILOT TASK 8.4

ROMANIAN PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
	Table-top exercises and preparation	**M13-M19**
RO – 01	Coordination/table-top exercises with fire brigades and other involved stakeholders related to the field exercises in Execution part 1 (ASFOR).	M13-M19
RO – 02	Survey of key information related to wildfires in Romania, as input to Execution part 1 and Post-processing (ASFOR).	M13-M19
RO – 03	Survey on information needed for insurance model on possible preventive actions (CBS/ASFOR/SMURD/MEWF).	M13-M19
RO – 04	Survey on information needed for catastrophe assessment (ASFOR/SMURD, CBS and DTU may assist).	M13-M19
RO – 05	Preparation for AR/VR module (SIMAVI): Evaluation of the proposed area (Vegetation, land, landmarks) Evaluation of the Romanian intervention methodology (OIG nr4018_IG) for integration in VR Simulation 3D mapping of the Macin Mountain proposed environment. (Drone recordings, measurements of the area, image aquisiton for generatig textures). Meeting on Macin city with firefighters for image aquisition, video recordings of the equipment used by the firefighters. Discussions on the methodology and with the intervention team.	M13-M19

	Potential activities pending involvement of other technology partners	
RO – 06	Survey on information needed for fire detection and decision support module for Execution part 2 and Post-processing (FI/ASFOR/SMURD).	M13-M19
RO – 07	Upgrade and customization of USAL modelling tools for their integration in the fire prevention system (USAL/SIMAVI)	M13-M19
	Execution part 1: Field visits at Romanian pilot site	**M19-M33**
RO – 08	Mounting of sensors (ASFOR/SMURD/SIMAVI). Identification of placement locations, potential outputs are Temperature, Humidity, Counting. Natural park, limited intervention to natural landscape need to be considered.	M19-M23
RO – 09	Deployment of forward outpost with access to electricity (ASFOR/SMURD). Identification of most appropriate location for connectivity and electricity.	M19-M23
RO – 10	Development of insurance models on possible preventive actions (CBS/ASFOR/ SMURD). Input is relevant information (e.g. topography and flora).	M19-M29
RO – 11	Catastrophe scenario assessment (ASFOR/ SMURD/ possibly DTU). Input is relevant information (e.g. topography and flora).	M19-M29
RO – 12	Firefighter AR/VR training (SIMAVI/ISU Tulcea/SMURD): - Process the multimedia materials (textures for the 3D models, videos) - 3D modelling for the firefighters' truck (Tulcea county firefighters department) - 3D modelling of the firefighters' equipment - 3D modelling for the environment (trees, grass, rocks, buildings, roads, mountains) - Develop the training module of AR/VR	M19-M33

	- Conduct training sessions with firefighters	
	Potential activities pending involvement of other technology partners	
RO – 13	Connectivity with TREEADS platform (USAL/ASFOR/ SMURD/SIMAVI/CBS/DTU/FI). Interlinking the different modules from the technology providers to the TREEADS platform.	M19-M33
	Execution part 2: Fire detection and response simulation in real environment	**M29-M33**
RO – 14	Planning of simulation actions in real environment (ISU Tulcea/ASFOR/SMURD)	M29-M33
RO – 15	Integration of available technologies with support of TREEADS platform for the real environment simulation (SIMAVI/USAL/FI) – ***USAL and FI are still pending for confirmation of involvement***	M29-M33
RO – 16	Simulation in real environment of scenario (SIMAVI/ISU Tulcea/ASFOR/SMURD)	M29-M33
	Post-processing	**M34-M40**
RO – 17	Comparison of training simulation results with actual real environment simulation	M34-M40
RO – 18	Report on potential improvement of existing fire intervention procedures	M38-M40
RO – 19	Dissemination of results at national level	M39-M40

ANNEX 4: SPANISH PILOT TASK 8.5

SPANISH PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
	Field exercises definition:	**M13-M19**
ES–01	Design of field exercises: - Definition of scenarios. - Final selection of field exercises and execution commitment through the definition of roles for each partner per exercise.	M13-M19
ES–02	Extraction of minimum logistical requirements for the deployment of physical elements provided by partners (Storage Logistics, Special Transport, Legal permits, Additional HR, Maximum distance to the exercise, Deploy Logistics, connectivity, power details, Time to full charge, autonomy)	M13-M19
ES–03	Selection of locations from among the candidates visited at the Avila Meeting for the selected exercises in (ES-1) considering the logistical requirements from (ES-2) for feasibility	M13-M19
ES–04	Definition of participants per exercise considering stakeholders (fire brigades for controlled burns; volunteer corps for prevention, preparation, restoration, or adaptation tasks; local area managers) and test teams	M13-M19
ES–05	Refinement of user stories (iterations) to adapt them to localizations and requirements. - Definition of use case for each exercise, including sequence Diagrams for each use case/exercise.	M13-M19
ES–06	Communication with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers to evaluate possible collaborations. - Initial scrutiny of eventual collaborators (Voluntary participation in TREEADS survey).	M13-M19

	- Survey on the relevance of the proposed exercises as a platform evaluation measure	
ES–07	Compilation of historical information and collection of public sources with relevant information of the area or historical data related to wildfires	M13-M19
ES–08	Define an on-field exercises execution plan, considering an incremental deployment of the solution TREEADS related with logistic and stational (official controlled burns dates, biomass prevention dates) requirements	M13-M19
	Logistic and Field exercises preparation	**M20-M26**
ES–09	Operational definition by localized field exercise.	M20-M26
ES–10	Study of the final area to verify compliance with logistic requirements.	M20-M26
ES-11	Selection of candidate spaces for storage logistics. Check electrical sources.	M20-M26
ES-12	Feasibility study of logistics candidates, study of costs and evaluation of logistics coordination.	M20-M26
ES-13	Final selection of logistic spaces per exercise. Final exercise Plan considering minimum logistic impact.	M20-M26
ES-14	Logistic Management and coordination with area managers and owners considering Exercises Planification (5).	M20-M26
ES-15	Coordination of field exercises with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers. Selection of possible collaborators (Voluntary participation survey). Study of legal implications of external participation. Safety and security protocols definition.	M20-M26

	Execution part 1	**M20-M38**
ES-16	Test the first integrated software functionalities of the platform (WP7 dependency)	M20-M38
ES-17	Prevention exercises that do not require of near-real time reports -do not require the deployment of aerial means and PCS-, including on-field operations using TREEADS knowledge	M20-M38
ES-18	Preparation/prevention exercises related with RRSS exploitation	M20-M38
ES-19	Restoration/adaptation exercises including on-field operations and the use of historical data, and the report generation. These exercises could include de deployment of UdG UAV, depending on logistics	M20-M38
ES-20	Fire spread Simulation's exercises	M20-M38
	Deployment Logistic tests and Execution part 2 preparation	**M27-M33**
ES-21	Individual flight tests of the aerial means (Drones), estimating autonomy and taking measurements of interest (max distance to target, altitude, etc.) - Vision Drones (ACCELI, UdG) - Lidar Drones (ACCELI) - Dissemination Drones (ACCELI) - Firefighting Drones (DH) - Cooldown Drones (DH)	M27-M33
ES-22	Individual flight tests of the aerial means (Zeppelin), estimating autonomy and taking measurements of interest (max distance to target, altitude, etc.)	M27-M33

ES-23	Mobile coverage deployment tests (PCS) measuring the limits of connectivity and the available bandwidth by zones	M27-M33
ES-24	Connectivity tests between the physical elements of the TREEADS ecosystem,	M27-M33
ES-25	Tests of sending data from sensors to the platform	M27-M33
ES-26	Tests of drone's swarm coordination	M27-M33
ES-27	Test drone seed pods dissemination in easy access area	M27-M33
ES-28	Measurements. Integration of the measurements into the TREEADS platform. Integrating the field measurements into the test methods in Execution part 2.	M27-M33
	Execution part 2	**M27-M38**
ES-29	Preparation of a high-risk area - which will imply the deployment of an alarm system and a complete monitoring of the terrain using all available physical means, together with the mobilization of relevant resources in case of fire (PCS, helmets, drones). We will take some measures: - Area covered by vision devices - Cartography precision - Number of features/information units per report - Time to obtain the full report for the selected area - Update rates - Time unit to start Early Warning System - Time to generate cartography using deployed resources - Number of people achieved using RRSS - Number of interactions using RRSS - Fire report localization accuracy	M27-M38

	(litres/kilometres)	
ES-30	Fire detection using Aerial means and Early warning System. We will take some measures: - Time from fire start to detection and report - Time to send alarms - Fire localization accuracy	M27-M38
ES-31	Fire extinguishing -exercise on controlled fire- using unmanned aerial means. We will take some measures: - Aerial firefighting drones time from base to fire objective - Time to full extinction using firefighting drones (in terms of area/hour) - Aerial firefighting drones model autonomy - Aerial firefighting drones model fuel consumption - Aerial firefighting UAV extinction time against traditional extinction means time - Times and performance comparation with other means	M27-M38
ES-32	Cooling down of hot spots detected by treads (USAL) through the use of UAV (DH). We will take some measures: - Aerial firefighting drones time from base to objective - Time to full cooldown using firefighting drones (in terms of area/hour) - Aerial firefighting drones model autonomy (different model for cool down) - Aerial firefighting drones model fuel consumption (different model for cool down) - Times and performance comparation with other means	M27-M38
ES-33	Seed pods dissemination in difficult access area using UAV. We will take some measures: - Soil Penetration - Soil state - Minimum Shoot velocity - Disseminated seed pods/time unit - Area covered/time unit	M27-M38

	Post-processing	**M34-M40**
ES-34	Collection of information and measurements of the exercises of the different executions.	M34-M40
ES-35	Evaluation measures collected in the different exercises.	M34-M40
ES-36	Summary of activities carried out in the pilots based on the field diary	M34-M40
ES-37	Evaluation of costs/benefits for each of the scenarios represented by the different phases of a forest fire (prevention, preparation, detection, response, restoration, and adaptation) based on the measures collected in execution part 2. Summary table of operation costs of each tool in logistical terms based on the execution costs.	M34-M40
ES-38	Creation of a document of suggestions to support the decision and the operation for each of the phases of a forest fire. Within the framework of each of the phases of a wildfire, this document must include an end-user tools guide, logistical requirements, tool functionality, tool target and a simple example of use. This document must include all the tools implemented in the Spanish pilot.	M34-M40
ES-39	Conclusions, successes and errors, possible improvements, and future work	M34-M40

ANNEX 5: AUSTRIAN PILOT TASK 8.6

AUSTRIAN PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
	Field exercises definition	**M13-M19**
AT-1-1	Design of field exercises. Definition of scenarios. Final selection of field exercises and execution commitment through the definition of roles for each partner per exercise.	M13-M19
AT-1-2	Extraction of minimum logistical requirements for the deployment of physical elements provided by partners (Storage Logistics, Special Transport, Legal permits, Additional HR, Maximum distance to the exercise, Deploy Logistics, connectivity, power details, Time to full charge, autonomy)	M13-M19
AT-1-3	Selection of locations from among the candidates	M13-M19
AT-1-4	Definition of participants per exercise considering stakeholders (fire brigades for controlled burns; volunteer corps for prevention, preparation, restoration, or adaptation tasks; local area managers) and test teams	M13-M19
AT-1-5	Refinement of user stories (iterations) to adapt them to localizations and requirements. Definition of use case for each exercise, including sequence Diagrams for each use case/exercise.	M13-M19
AT-1-6	Communication with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers to evaluate possible collaborations. Initial scrutiny of eventual collaborators (Voluntary participation in TREEADS survey).	M13-M19

AT-1-7	Define an on-field exercises execution plan, considering an incremental deployment of the solution TREEADS related with logistic and stational (official controlled burns dates, biomass prevention dates) requirements	M13-M19
	Logistic and Field exercises preparation	**M20-M26**
AT-2-1	Operational definition by localized field exercise.	M20-M26
AT-2-2	Study of the final area to verify compliance with logistic requirements.	M20-M26
AT-2-3	Selection of candidate spaces for storage logistics. Check electrical sources.	M20-M26
AT-2-4	Feasibility study of logistics candidates, study of costs and evaluation of logistics coordination.	M20-M26
AT-2-5	Final selection of logistic spaces per exercise. Final exercise Plan considering minimum logistic impact.	M20-M26
AT-2-6	Logistic Management and coordination with area managers and owners considering Exercises Planification (5).	M20-M26
AT-2-7	Coordination of field exercises with interested parties, placing special emphasis on contact with fire officials, spokespersons for volunteer associations and area managers. Selection of possible collaborators (Voluntary participation survey). Study of legal implications of external participation. Safety and security protocols definition.	M20-M26
	Execution part 1	**M27-M33**

AT-3-1	Test the first integrated software functionalities of the platform (WP7 dependency)	M27-M33
AT-3-2	Prevention exercises that do not require of near-real time reports -do not require the deployment of aerial means and PCS-, including on-field operations using TREEADS knowledge	M27-M33
AT-3-3	Preparation/prevention exercises related with RRSS exploitation	M27-M33
AT-3-4	Restoration/adaptation exercises including on-field operations and the use of historical data, and the report generation. These exercises could include de deployment of UdG UAV, depending on logistics	M27-M33
AT-3-5	Fire spread Simulations	M27-M33
	Execution part 2, including Deployment Logistic tests and Execution part 2 preparation	**M27-M33**
AT-4-1	Individual flight tests of the aerial means (Zeppelin, Drones), estimating autonomy and taking measurements of interest (max distance to target, altitude, etc.)	M27-M33
AT-4-2	Mobile coverage deployment tests (PCS) measuring the limits of connectivity and the available bandwidth by zones	M27-M33
AT-4-3	Connectivity tests between the physical elements of the TREEADS ecosystem	M27-M33
AT-4-4	Tests of sending data from sensors to the platform	M27-M33
AT-4-5	Tests of drone's swarm coordination	M27-M33
AT-4-6	Test drone seed pods dissemination in easy access area	M27-M33

AT-4-7	Study the feasibility to deploy full TREEADS power. Here we will take lot of measures related with economic costs	M27-M33
AT-4-8	The preparation of a high-risk area - which will imply the deployment of an alarm system and a complete monitoring of the terrain using all available physical means, together with the mobilization of relevant resources in case of fire (PCS, helmets, drones). We will take some measures: • Area covered by vision devices • Cartography precision • Number of features/information units per report • Time to obtain the full report for the selected area • Update rates • Time unit to start Early Warning System • Time to generate cartography using deployed resources • Number of people achieved using RRSS • Number of interactions using RRSS • Fire report localization accuracy • (litres/kilometres)	M27-M33
AT-4-9	Fire detection using Aerial means and Early warning System. We will take some measures: • Time from fire start to detection and report • Time to send alarms • Fire localization accuracy	M27-M33
AT-4-10	Fire extinguishing -exercise on controlled fire- using unmanned aerial means. We will take some measures: • Aerial firefighting drones time from base to fire objective • Time to full extinction using firefighting drones (in terms of area/hour) • Aerial firefighting drones model autonomy • Aerial firefighting drones model fuel consumption • Aerial firefighting UAV extinction time against traditional extinction means time • Times and performance comparation with other means	M27-M33

AT-4-11	Cooling down of hot spots detected by treads (USAL) through the use of UAV (DH). We will take some measures: • Aerial firefighting drones time from base to objective • Time to full cooldown using firefighting drones (in terms of area/hour) • Aerial firefighting drones model autonomy (different model for cool down) • Aerial firefighting drones model fuel consumption (different model for cool down) • Times and performance comparation with other means	M27-M33
AT-4-12	Satisfaction surveys for external participants and public present in this execution exercises.	M27-M33
AT-4-13	Integration of the results into the TREEADS platform.	M27-M33
	Post-processing	**M34-M40**
AT-5-1	Summary of activities carried out in the pilots based on the field diary	M34-M40
AT-5-2	Collection of information and measurements of the exercises of the different executions.	M34-M40
AT-5-3	Evaluation measures collected in the different exercises.	M34-M40
AT-5-4	Evaluation of costs/benefits for each of the scenarios represented by the different phases of a forest fire (prevention, preparation, detection, response, restoration and adaptation) based on the measures collected in execution part 2.	M34-M40
AT-5-5	Summary table of operation costs of each tool in logistical terms based on the execution costs.	M34-M40

ANNEX 6: GERMAN PILOT TASK 8.7

GERMAN PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
	Table-top exercises & preparations	**M7-M19**
DE -1	Survey and evaluation of relevance of test methods for *Execution part 1 and 2*	M7 - M12
DE -2	For Execution part 1: Survey of relevant background information and relevant guidelines for activity Post-processing. Survey of key information related to wildfires in Germany, as input to Execution part 2 and Post-processing.	M7 - M19
DE -3	For Execution part 2: Survey of large-scale outdoor fire experiment in the pilot region Saxony-Anhalt (forest fire investigation) and real-scale fire tests on test site TTS in Horstwalde, BAM Survey on examination methods of the effects of foam (concentrates) on the growth and development of plants	M10 - M19
	Execution part 1: Small- and mid-scale experiments	**M7-M26**
DE - 4	Experimental studies of flame spread, fire behaviour with ground specimens of different vegetations in BAM and OVGU labs with temperature measurements smoke gas analysis.	M7 - M26
DE – 5	Smoke gas analysis in the DIN tube	M10 - M20
DE – 6	Self-ignition behaviour in the Sedex furnace	M10 - M20
DE – 7	Flammability and extinguishing tests (outdoor and under the calorimeter hood)	M7 - M26

DE – 8	Flow field investigations	M10 - M20
DE – 9	Extinguishment experiments with foam and Pyrobubbles in mid-scale experiments	M10 - M26
	Execution part 2-1: Real-scale fire experiments	**M19-M33**
DE - 10	Real-scale fire tests on test site TTS in Horstwalde, BAM Experimental studies of ground specimens up to 4 m^2 with different ignition methods and extinguishment methods, temperature measurements, fire spread and smoke spread measurements	M19 - M30
DE – 11	Extinguishment experiments with foam and Pyrobubbles in real-scale experiments	M22 - M30
	Execution part 2-2: Ground fires	**M19-M33**
DE - 12	Perform large scale fire tests in model area in Saxony-Anhalt (forest fire investigation) Experimental studies of ground specimens up to 100 m^2 with different extinguishment and fire barrier methods, temperature measurements, fire spread and smoke spread measurements	M21 - M23
DE - 13	Evaluation of different tactics of firefighting with water and foam and Pyrobubbles in forest fires	M19 - M33
DE - 14	Evaluation of different nozzles and lances with their effectiveness of firefighting on and in the ground	M19 - M33

DE - 15	Evaluation and optimization of foam characteristics (e. g. water-air-ratio) for the use on ground and underground wildland fires	M19 - M25
DE –16	Post-processing: includes analysis, results and conclusions from fire experiment series in Execution part 1 and 2 and numerical fire simulations (set-up numerical model, physical properties and measured quantities e.g. mass burning rate, temperatures etc.)	M24 - M33
	General step: simulation with CFD	
DE - 17	Numerical fire simulations (set-up numerical model, physical properties and measured quantities e.g. mass burning rate, temperatures etc.)	M19 - M33
	General step: effects of foam on environment	
DE - 18	Examination of the effects of foam (concentrates) on the growth and development of plants	M19 - M33

ANNEX 7: GREEK PILOT TASK 8.8

GREEK PILOT DEFINED BY ACTIVITIES

Activity	Definition of activity	Schedule (start-end)
	Table-top exercises & preparations	**M13-M19**
GR-01	The Fire Danger Index is a mature product developed in the premises of WP4 - T4.1. (NOA)	M15-M18
GR-03	AR helmets are to be developed within the framework of WP5 – T5.4. (8BELLS)	M18-M19
GR-04	The X/BELLO secure incident-management toolset for decision making and communication to all respective stakeholders on Samaria is to be developed within WP4-T4. (8BELLS)	M16-M19
GR-05	Visual object recognition technology is to be developed within WP5 -T5.1. (8BELLS)	M16-M19
GR-06	A resilient and smart framework for event-driven and context-aware fire detection is to be developed in WP5-T5.7. (USAL)	M16-M19
GR-07	CO and PM sensors will be implemented on the AR Helmet of GR-03 activity. Also, a plume dispersion model will be implemented for different scenarios for the Pilot (T4.2). (NCSRD)	M16-M19
	Execution part 1: Field exercises in Greek Pilot.	**M13-M38**
GR-01	The Fire Danger Index is a mature product developed in the premises of WP4 - T4.1. (NOA)	M15-M18
GR-02	UAVs are being developed in the framework of WP5 – T5.3 and T5.5. (ACCELI)	M18-M22

Plume dispersion model will be implemented for different scenarios for the Pilot (T4.2). (NCSRD)

GR-05	Visual object recognition technology is to be developed within WP5 -T5.1. (8BELLS)	M18-M22
GR-06	A resilient and smart framework for event-driven and context-aware fire detection is to be developed in WP5-T5.7. (USAL)	M18-M22
GR-07	Plume dispersion model will be implemented for different scenarios for the Pilot (T4.2). (NCSRD)	M18-M22
	Execution part 2: Development and execution of a controlled and realistic test method	**M18-M38**
GR-01	The Fire Danger Index is a mature product developed in the premises of WP4 - T4.1. (NOA)	M30-M38
GR-02	UAVs are being developed in the framework of WP5 – T5.3 and T5.5. (ACCELI)	M30-M38
GR-03	AR helmets are to be developed within the framework of WP5 – T5.4. (8BELLS)	M30-M38
GR-04	The X/BELLO secure incident-management toolset for decision making and communication to all respective stakeholders on Samaria is to be developed within WP4-T4. (8BELLS)	M30-M38
GR-05	Visual object recognition technology is to be developed within WP5 -T5.1. (8BELLS)	M30-M38
GR-06	A resilient and smart framework for event-driven and context-aware fire detection is to be developed in WP5-T5.7. (USAL)	M30-M38
GR-07	CO and PM sensors will be implemented on the AR Helmet of GR-03 activity. (NCSRD)	M30-M38

Plume dispersion model will be implemented for different scenarios for the Pilot (T4.2). (NCSRD)

ANNEX 8: TAIWAN PILOT TASK 8.9

TAIWAN PILOT DEFINED BY ACTIVITIES

Number	Definition of activity	Schedule (start-end)
TW - 1	Produce the AAM concrete and cement paste concrete with wood ash - Engineering properties of concrete samples - Microstructure of paste and concrete samples - Fire resistance performance of concrete samples	M01-M18
TW - 2	Determine the pilot location	M12-M15
TW - 3	Produce the hollow brick from concrete and build up the pilot case - Produce the hollow brick samples in laboratory - Deliver to the Pilot case location - Install the Pilot case	M15-M24
TW - 4	Build up the fire detection and weather conditions monitoring system and IoT network and then trial test in the laboratory 1. Set up a weather box with sensors to determine the weather conditions and data records: • Temperatures • Humidity • Smoke concentration • Fire concentration 2. Establish the IoT system and connect with weather box	M12-M24
TW - 5	Develop the fire and smoke spread simulation model	M15-M24

Plume dispersion model will be implemented for different scenarios for the Pilot (T4.2). (NCSRD)

TW - 6	Attach the weather box to the pilot case	M24-M30
TW - 7	Collect data and prepare the report - Weather condition data - Non-destructive test data for concrete - Fire spread simulation result	M30-M42

A Holistic Fire Management Ecosystem for Prevention, Detection and Restoration of Environmental Disasters

The Members of the TREEADS Consortium:

Short Name	Country	Short Name	Country	Short Name	Country
FRN	NO	**INNOV**	CY	**DCNA**	AT
Jotne	NO	**FI**	EL	**IFR**	AT
BAM	DE	**GBD**	BE	**FF GPK**	AT
Altran	ES	**EFB**	EL	**BFG**	AT
DH	ES	**LAMMC**	LT	**STRESS**	IT
USAL	ES	**OS**	DE	**ACaMIR**	IT
SQD	BE	**VIPO**	NO	**Sorrento**	IT
CARTIF	ES	**WAS**	NO	**PUI**	FR
UdG	ES	**CBS**	DK	**FAFCYLE**	ES
NCSRD	EL	**K3Y**	BG	**DdA**	ES
SIMAVI	RO	**MAGG**	IT	**TUC**	EL
OVGU	DE	**NOA**	EL	**MAICh**	EL
ADRESTIA	EL	**MEWF**	RO	**DAAC**	EL
CERTH	EL	**ASFOR**	RO	**NTUST**	TW
8BELLS	CY	**SMURD**	RO	**DTU**	DK
ACCELI	CY	**JOAFG**	AT		

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