ET-PP WP9 – Support for developing a Sustainability Strategy for ET

Introduction

Background

The Einstein Telescope (ET) is a proposed underground facility to host a gravitational-wave observatory. ET will make it possible, for the first time, to explore the Universe through gravitational waves along its cosmic history up to the cosmological dark ages, shedding light on open questions of fundamental physics and cosmology.

As part of the ET Preliminary Phase (ET-PP) framework, Work Package 9 (WP9) – "Sustainability" is a fully integrated technical WP of the project, with connections across all other WPs. Sustainability considerations will be included at all steps of the ET design process and will be constantly adapted to match the progress of these developments. Sustainability will not be an abstract concept; it will always be applied to match the needs and the requirements of the ET.

WP9 has delivered a preliminary sustainability plan (PSP). This plan describes the sustainability goals and how identified issues will be addressed as part of the ET project, focussing on its importance, methodology for study of the topic, and the different phases of the ET project for which sustainability will be relevant.

Scope

This proposal sets out our understanding of the main aims, needs and challenges from PSP and background documents from the ET-PP INFRA-DEV meetings.

Arup's role through this commission will be to provide technical advisory services to ET-PP WP9 in support of the refinement and development of the sustainability plan into a more advanced strategic document that needs to be completed by October 2025.

The tasks outlined below aim to provide WP9 with a range of specialist engineering, sustainability and wider technical services that will support in establishing robust plans and strategies, and consistent approaches in implementing this considering the preliminary design across the proposed sites.

The tasks identified are expanded in more detail in the following section.

Tasks

Task 1: **Preliminary Sustainability Plan (PSP) Milestone M9.1 – Review**
Context: The Preliminary Sustainability Plan (PSP) is the first milestone (M9.1) of Work Package 9 (WP9) "Sustainable Development Strategy" within the Preparatory Phase for the Einstein Telescope Gravitational Wave Observatory project (ET-PP). The PSP describes how sustainability, including

economic, environmental and societal impacts of the Einstein Telescope, will be addressed as part of the preparatory phase.

Activity:

Review the PSP v2.0 draft that has received feedback from reviewers at the European Commission (EC) in line with good practice expected of a PSP for a major infrastructure project at the preliminary phase, and in consideration of the current feedback received to the ET-PP team.

Programme:

ET-PP is required to deliver the final PSP in 5th May 2025. The timeline below is proposed to enable ET-PP in achieving this timeline.

a) Review final draft v2.0 and any supporting comments received by ET-PP team: Receive by April 14th 2025 - 2 weeks review period.

b) Ad-hoc support to WP9 team to finalise PSP: April 28th 2025 to May 2nd 2025

Assumptions:

A single iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the PSP authors through each round of draft to provide clarity or further recommendation.

Arup will not be providing substantive text or narrative to the PSP but comments at high level, structural or of a recommendation nature. Reference to existing good practice documents may be provided as part of the feedback review.

Inputs: PSP draft, EC officer and ETO review comments and any guidance available on acceptance criteria, feedback and communication with ET-PP members involved in the PSP's development.

Deliverable:

Findings from Arup's review shall be delivered in the form of review comments. This shall be in the form of a standalone comments table or in-line review commentary markup within the PSP drafts. As it is unknown what level of support may be required to support WP9 to finalise the PSP in part b) of the programme, an assumption of 3 days effort has been allocated at this stage.

Task 2:

Task 2a: ET Environmental impact assessment and mitigation strategy (D9.2) –Structure Definition

Task 2b: ET CO2 footprint ET assessment and mitigation strategy (D9.3) –Structure Definition

Context: D9.2 and D9.3 are two of the three key deliverables for WP9, alongside D9.1 ET Sustainable Development Implementation Strategy, to demonstrate under the WP9 "Sustainable Development Strategy" within the ET-PP.

Strategy documents do not contain substantive content or structure. It is understood that ET-PP's overall objectives of these documents, alongside D9.1, is to:

1. Study and minimize the carbon footprint of ET, including computing and travel.

2. Evaluate and minimize the landscape and environmental impact.

3. Evaluate the contributions of the infrastructure to the UN sustainable goals.

Activity:

Provide review and structuring advice for D9.2 and D9.3. As the current status of these documents is in early development by the ET-PP team, this task will involve reviewing any plans or documentation that may serve as underpinning information, and engagement with the WP9 teams responsible for authoring the documents to better understand the context and aims. It is expected that the structuring and topic and themes advice shall be in line with current good practice of documents of similar nature for a major infrastructure project at the preliminary phase, and is expected to align as a minimum with what is understood to be ET-PP's overall objectives for these documents i.e. consideration of

- Landscape, environmental and societal impact
- Assessing and minimizing the ET impact on its environment.
- Environmental management approach.
- Analyse and define an overall strategy for the reclamation, reuse and recycling of the excavated materials
- ET Carbon footprint assessment and mitigation
- ET carbon budget
- ET Energy consumption optimization

Across D9.2 and D9.3 we aim to:

- Support in developing a methodology, approach and structure that helps enable delivery by the strategy documents owner and consistency across the strategies. It is understood that INFN is the document owner for D9.2, EGO is the document owner for D9.3.
- Engage with INFN, EGO, CNRS to establish and define their scope for delivery of these documents and support that is required.
- Developing a framework that allows for commonality of comparison across the current candidate sites, and the possibilities for future new candidate's sites.

Programme:

ET-PP is required to deliver D9.2 and D9.3 in October 2025. The timeline below is proposed to support ET-PP in achieving this timeline.

a) Develop draft structure: Define structure and framework, review supporting documentation and references. Start of 14 April 2025 - 1 month development period. Completion 12th May 2025. (note ET-PP conducting EC Review meeting on 15th May)

b) Develop final structure: Developed final structure proposal for WP9 to review, and steps for implementation including table of roles and responsibility for delivery, in collaboration with WP9. Start 26th May 2025 - 1 month development period. Completion 27th June 2025.

Assumptions:

A single iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the WP9 representatives through each round of draft to provide clarity or further recommendation.

Arup will not be providing substantive text or narrative to the review and structuring template document for D9.2 and D9.3, comments are expected to be high level, structural or of a recommendation nature. Authorship of the final document D9.2 and D9.3 based upon the template and structure produced is the responsibility of INFN and EGO respectively, unless otherwise defined and agreed in separate tasks or instruction.

Inputs: Any strategy development documents that identify the requirements of the strategy, supporting work undertaken to develop this to date and the acceptance criteria used by the European Commission. Any background material e.g. presentation slides, requirements document from the current / local ET feasibility design works being undertaken.

Deliverable:

A word document structure and template for D9.2 and D9.3 with guidance points on levels of detail and a framework that enables consistency across documents and potential future sites. Essentially a basis document, upon which the developed strategy can be developed.

Task 3:

ET Environmental impact assessment and mitigation strategy (D9.2) – Report Authorship

Context: As set out in Task 2. This task will take forward the structure and framework developed in Task 2 and produce authorship of the strategy document itself, for draft and final review and approval from INFN.

Activity:

It is expected that the strategy shall be in line with current good practice of documents of similar nature for a major infrastructure project at the preliminary phase and is expected to align as a minimum with what is understood to be ET-PP's overall objectives for these two documents set out in Task 2, and the deliverable from Task 2.

Reference to relevant guidelines to inform the granularity of detail shall be made, which is expected may include:

- PAS2080 Carbon management
- EU Environmental Impact Assessment (EIA) Directive (2011/92/EU)
- Environmental Considerations checklist for European Strategy Forum on Research Infrastructures (ESFRI)

Programme:

ET-PP is required to deliver D9.2 in October 2025 so the timeline below is required

c) Develop draft report: Start 30th June 2025 - 1 month development period. Completion 25th July 2025.

d) Deliver final report: Start 25th July 2025 - 1 month development period. Completion 25th August 2025.

Assumptions:

Two rounds of iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the WP9 representatives through each round of report draft to provide clarity or further recommendation.

Deliverable:

Word document report

Task 4 [optional]:

ET CO2 footprint ET assessment and mitigation strategy (D9.3) – Report Authorship

Context: This task will take forward the structure and framework developed in Task 2 and produce authorship of the strategy document itself, for draft and final review and approval from EGO and INFN.

Activity:

It is expected that the strategy shall be in line with current good practice of documents of similar nature for a major infrastructure project at the preliminary phase, and is expected to align as a minimum with what is understood to be ET-PP's overall objectives for these two documents set out in Task 2, and the deliverable from Task 2.

Reference to relevant guidelines to inform the granularity of detail shall be made, which is expected may include:

- PAS2080 Carbon management
- EU Environmental Impact Assessment (EIA) Directive (2011/92/EU)
- Environmental Considerations checklist for European Strategy Forum on Research Infrastructures (ESFRI)

Programme:

ET-PP is required to deliver D9.3 in October 2025 so the timeline below is requested:

a) Develop draft report: Start 30th June 2025 - 1 month development period. Completion 25th July 2025.

b) Deliver final report: Start 25th July 2025 - 1 month development period. Completion 25th August 2025.

Assumptions:

A single iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the WP9 representatives through each round of report draft to provide clarity or further recommendation.

Deliverable:

Word document report

Task 5:

ET Sustainable Development Implementation Strategy (D9.1) – Structure Definition

Context: D9.1 is one of the three key deliverables for WP9 to demonstrate, alongside D9.2 and D9.3, under the WP9 "Sustainable Development Strategy" within the ET-PP.

The strategy document currently does not contain substantive content or structure and ET-PP's overall objectives of this document, alongside D9.2 and D9.3, is to:

1. Study and minimize the carbon footprint of ET, including computing and travel.

2. Evaluate and minimize the landscape and environmental impact.

3. Evaluate the contributions of the infrastructure to the UN sustainable goals.

Activity:

Review and structuring advice for D9.1 including the outcomes of D9.2 and D9.3 and reviewing any plans or documentation that may serve as underpinning information, and engagement with the WP9 teams responsible for authoring the documents to better understand the context and aims. It is expected that the structuring and topic and themes advice we provide shall be in line with current good practice of documents of similar nature for a major infrastructure project at the preliminary phase, and is expected to align as a minimum with what is understood to be ET-PP's overall objectives for these documents i.e. consideration of:

- Landscape, environmental and societal impact
- Assessing and minimizing the ET impact on its environment.
- Environmental management approach.
- Analyse and define an overall strategy for the reclamation, reuse and recycling of the excavated materials
- ET Carbon footprint assessment and mitigation
- ET carbon budget
- ET Energy consumption optimization

Aims are to:

- Support in developing a methodology, approach and structure that helps enable delivery by the strategy documents owner and consistency across the strategies. It is understood that CNRS is the document owner for D9.1.
- Engage with INFN, EGO, CNRS to establish and define their scope for delivery of these documents and support that is required.
- Developing a framework that allows for commonality of comparison across the current candidate sites, and the possibilities for future new candidate's sites.

Programme:

ET-PP is required to deliver D9.1 in October 2025 so the timeline below is proposed

a) Develop draft structure: Define structure and framework, review supporting documentation and references. Start of 30th June 2025 - 1 month development period. Completion 21st July 2025.

b) Develop final structure: Developed final structure proposal for WP9 to review, and steps for implementation including table of roles and responsibility for delivery, in collaboration with WP9. Start of 21st July 2025 - 1 month development period. Completion Start of 11th August 2025.

Assumptions:

A single iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the WP9 representatives through each round of draft to provide clarity or further recommendation.

Arup will not be providing substantive text or narrative to the review and structuring template document for D9.1, comments are expected to be high level, structural or of a recommendation nature. Authorship of the final document D9.1 based upon the template and structure produced is the responsibility of WP9, unless otherwise defined and agreed in separate tasks or instruction.

Inputs: Any strategy development documents that identify the requirements of the strategy, supporting work undertaken to develop this to date and the acceptance criteria used by the European Commission.

Deliverable:

A word document structure and template for D9.1 with guidance points on levels of detail and a framework that enables consistency across documents and potential future sites. Essentially a basis document, upon which the developed strategy can be developed.

Task 6 [optional]:

ET Sustainable Development Implementation Strategy (D9.1) – Report Authorship

Context: This task will take forward the structure and framework developed in Task 5 and produce authorship of the strategy document itself, for draft and final review and approval from CNRS (reference for this report) and INFN.

Activity:

It is expected that the strategy shall be in line with current good practice of documents of similar nature for a major infrastructure project at the preliminary phase and is expected to align as a minimum with what is understood to be ET-PP's overall objectives for this document set out in Task 5, and the deliverable from Task 5.

Reference to relevant guidelines to inform the granularity of detail shall be made, which is expected may include:

- PAS2080 Carbon management
- EU Environmental Impact Assessment (EIA) Directive (2011/92/EU)
- Environmental Considerations checklist for European Strategy Forum on Research Infrastructures (ESFRI)

Programme:

ET-PP is required to deliver D9.1 in October 2025 so the timeline below is proposed:

a) Develop draft report: Start of 11th August 2025 - 1 month development period. Completion 1st September 2025.

b) Deliver final report: Start of 8th September 2025 - 1 month development period. Completion Start of 6th October 2025.

Assumptions:

A single iteration of comment review and feedback per stage between Arup and the WP9 representative(s)

An online meeting to discuss the comments with the WP9 representatives through each round of report draft to provide clarity or further recommendation.

Deliverable:

Word document report

Task 7:

Workshops and Meetings Participation

Context: Various collaborator meetings and workshops are expected to occur until October 2025. Tentative dates are set out below, to be confirmed with the project's teams at least 2 weeks in advance of the event:

	Date	**Location**	**Theme**
Core			
W1	May 5th – 9th 2025 (May 8th for planning purposes)	Hybrid | In-person, Geneva	WP9 progress meeting
W2	May 12th – May 15th 2025 (May 12th for planning purposes)	Hybrid | In-person, Geneva or European location, Stockholm	Preparation meeting on D9.2 and D9.3 for EC Review Meeting
W3	September 15th 2025 (TBD)	Hybrid | In-person, Barcelona	ETPP annual meeting
W4	November 12th – 13th 2025	Hybrid | In-person, Rome	Sustainability of large infrastructure Meeting

Activity:

Preparation of material for meeting and presentations

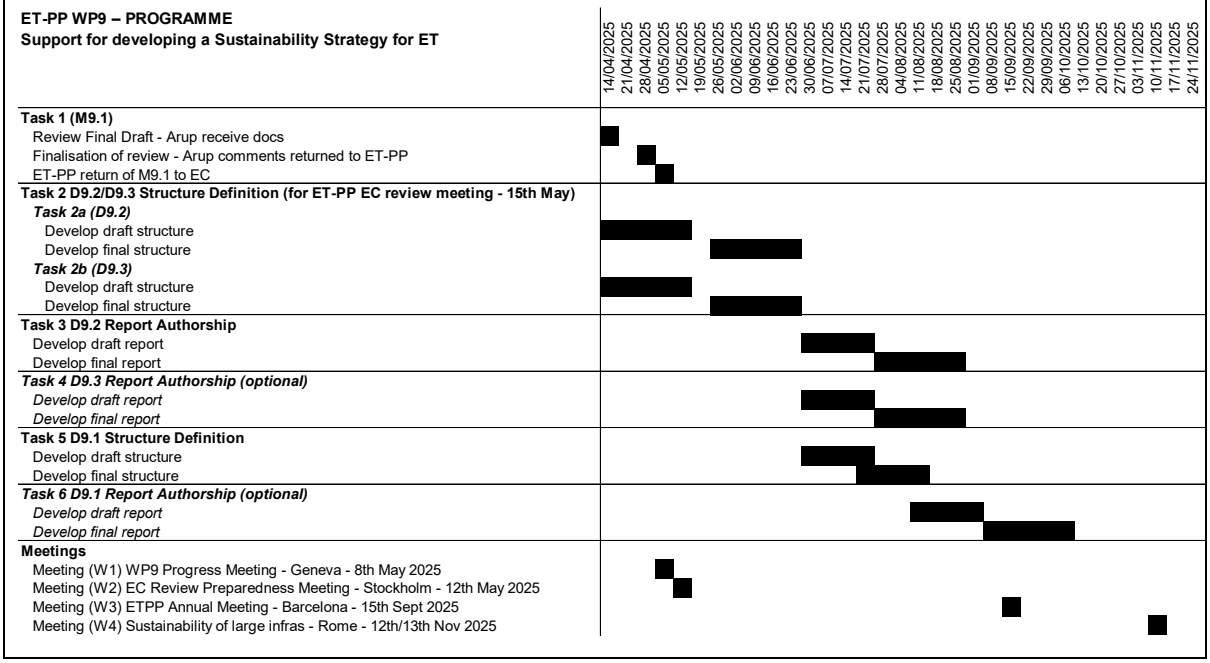
In addition, for each Task an online meeting with ET-PP stakeholders is accounted for if required at the start, end and approximate mid-point of each task to review and discuss inputs and updates on each task.

Programme:

As above

Assumptions:
In person for at least 2 of the W1 to W4 meetings, which shall be attended by at least 1no. Arup people in person
Deliverable:
Workshop material and contributions to discussions and meetings

Table 1: Overall programme of tasks



In addition to these task specific deliverables, throughout the course of this project we have accounted for:

- A monthly progress meeting with M. Marsella, INFN representative, and WP9 participant, reasonable ad-hoc advice and opinion through email correspondence relating to progress and support around the tasks, direction of the commission, and project management and administration of this contract.
- A task briefing meeting to kick-off and report at each sub-task stage has been assumed.
- Unless otherwise indicated, all workshops and meetings are assumed to take place remotely online, or in-person at Arup London's office, where access to INFN or their collaborators will be made available.
- Deliverables shall be submitted at the end of each programme stage.
- It is understood that the PSP, D9.1, D9.2 and D9.3 final strategy reports will be reviewed by an independent European Commission officer. Arup is not responsible or liable for their acceptance or otherwise of these documents. EC's decision is unlinked to Arup's scope of works and INFN's payment to Arup on development of any work

towards these documents. However, early engagement with the EC on their expectations and assessment criteria, can help mitigate against this.

- The project manager identified by Arup is Yung Loo, who will be the main point of contact for the study. The project director for this commission is Matt Sykes.

Remuneration and Payment

The allocated budget for this order is EUR 80,000 for the Core tasks, and EUR 60,00 for the Optional tasks, including expenses. The allocation of the budget to the different Tasks follows:

Core Tasks

Task	Topic	Fee (Euros)
1	Preliminary Sustainability Plan (PSP) – Review	8,000
2a	ET Environmental impact assessment and mitigation strategy (D9.2) – Structure Definition	12,000
2b	ET CO2 footprint ET assessment and mitigation strategy (D9.3) – Structure Definition	12,000
3	ET Environmental impact assessment and mitigation strategy (D9.2) – Report Authorship	27,000
5	ET Sustainable Development Implementation Strategy (D9.1) – Structure Definition	12,000
7	Meetings and Workshops	9,000
Total		**80,000**

Optional Tasks

Task	Topic	Fee (Euros)
4	ET CO2 footprint ET assessment and mitigation strategy (D9.3) – Report Authorship	27,000
6	ET Sustainable Development Implementation Strategy (D9.1) – Report Authorship	27,000
-	Ad-Hoc support	6,000
Total		**60,000**

The ad-hoc support shall include ad-hoc support either through attendance into additional meetings or personnel, or other tasks that may be required, which are not defined within this current scope. If in-person attendance is required on site these will need to be agreed on cost basis.

Call off rates from the table below should apply:

Role	Off site Rate (Euros – day rate)
Engineer	687
Senior Engineer	1,021

Associate	1,276
Associate Director	1,643
Director	2,598

If in-person attendance is required on site, an additional rate of 800 Euros shall be applied to the rates for a 1-day visit, and 350 Euros for any consecutive days if required. This has been assumed for a meeting in Geneva, Barcelona, Stockholm, Rome. Should other sites be required, e.g. to less accessible mainland Europe city locations, these will need to be agreed on a mutually agreed cost basis.

The unit rates remain firm until the 1st April of each year, thereafter an annual escalation of 5% shall be applied.

I accept the above terms and conditions

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For and on behalf of [ ]

Firmato digitalmente da: Paola Puppo
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