1st ET-PP review meeting: WP9 – Sustainability

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On behalf of the working group

Horizon Europe: Coordination and Support Actions

14/12/2023

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WP 9: Introduction and objectives

- Sustainable development strategy for Einstein Telescope (ET)
  - Minimize the global carbon footprint of the Einstein Telescope (ET)
  - Evaluate landscape, environmental and societal impact and how to implement valorization and mitigation actions
  - Contribute to sustainable goals (enforce a strong multidisciplinary approach by addressing other science-based targets for natural hazards and climate change mitigation)
- WP coordinators
  - Initially: Prof. Stavros Katsanevas, EGO director (he passed away end of 2022)
  - Now: **Nicolas Arnaud – CNRS researcher, seconded to EGO**
    Maria Marsella – Roma Sapienza University, professor
- Participants
  - CNRS, EGO, INFN, MUL (Montanuniversität Leoben)
- First year goals
  - Identify all sustainability issues linked to ET
  - Encourage the research community to raise awareness on sustainability
  - Establish a methodology to measure the various ET impacts
  - Identify best practices and foreseen mitigation actions

WP 9: Tasks

- ET carbon footprint assessment and mitigation
    - ET carbon budget
    - Optimization of the ET energy consumption
- Landscape, environmental and societal impact
    - Assessing and minimizing the ET impact on the environment
    - Environmental management approach
    - Analyze and define an overall strategy for the reclamation, reuse and recycling of the excavated materials (MUL)

Adopted approach

- Follow the documentation to use up-to-date references (rapidly evolving)
- Establish contacts within ET and its different bodies and other research infrastructure (CERN, EGO and other GW obs.)
- Open a view beyond ET research, towards industry and socio-economic impacts
- Establish collaboration with research centers or large collaborations and examine bottom-up approaches
- Identify key indicators and standard metrics to measure impacts

WP 9: Analyze and define an overall strategy for the reclamation, reuse and recycling of the excavated materials

- MUL Participants
  - Robert Galler, Univ. Prof. Dr. mont, DI, Head of Subsurface Engineering
  - Elisabeth Hauzinger, DI, PhD student on topic of reuse of excavation material
  -
- Einstein Telescope: a civil engineering challenge
  - triangular or L-shape, total tunnel length of 30 km & diameter of 7 m
  - caverns, service, access tunnels and shafts for a total excavated volume ~ 4.4 Mio m^3 ↔ muck volume ~ 5.3 Mio m^3
  - Exact location not yet determined

  - identify site-specific parameters since a lot depends on geology and the regional market/industry
  - Strategy to keep anthropogenic pollution of excavated material to a minimum (excavation method)
  - Identify possible reuse scenarios for the excavation material which have a low impact on environment

WP 9: Critical risks, deviations from Annex I, contingency plans

Understand what sustainability means for ET

- Sustainability needs to be precisely defined per domain
- Focus on all aspects of sustainability and establish priorities
- Involve experts

Next steps

- Gathering info/data from ET-PP, ETO and the ET collaboration (requests included in the PBS)
- Enforce/establish the liaisons with other WPs (WP4, 5, 6, 7, 8 and 10)
- Collaboration with CERN to provide comparative environmental assessment for ET and other GW observatory and life cycle assessment
- Establishing a WG on sustainability assessment
- Fully dedicated person (to be recruited in 2024)

WP 9: Deliverables and milestones

First milestone: Preliminary sustainability plan - delivered on October 31st

- *Describe how sustainability questions will be addressed as part of the Einstein Telescope (ET) project.*
- *Motivate the importance of sustainability for a large and durable future research infrastructure like ET,*
- *Define the methodology that will be adopted and*

  the necessity to formulate key indicators and figures of merit for quantitative analysis
- *Highlight the need to differentiate the analysis for each different phases of the ET project*

WP 9: Preliminary sustainability plan key messages

Sustainability strategy will accompany the development of ET and
help optimizing (reducing) its impacts in all project phases over several decades

- Preparatory and design
- Construction
- Operation
- Upgrades
- Dismantling

Across all fields relevant for ET

- Instrumentation, engineering, computing (hardware, software computing centers), data analysis
- Open science
- Applications to society, outreach and communication

Based on the UN Sustainable Development goals (mainly 9 and 7)

- Account for the three pillars of sustainability: environmental, social and economic

WP 9: Preliminary sustainability plan key messages

- A wide set of targets
  - Greenhouse gas emissions
    - Energy management system, Optimizing the usage of natural resources
  - Infrastructure impact
    - Sustainable procurement strategy
  - Travels
  - Life-cycle analyzes

- Overall goals: reducing impacts as much as possible
  - Estimating and measuring these impacts
  - Quantitative recommendations: scope by scope or sector by sector
  - Define set of standards and references to monitor progress over time
  - Skilled people and experts required to identify new sustainability-wise solutions

WP 9: Contribution from each partner

INSTITUTION		PM as per Annex I	PM in the period
2 INFN	CONTRIBUTIVES	39,2	0
	REQUESTED EC	18	0
4 CNRS	CONTRIBUTIVES	13	0,33
	REQUESTED EC	0	0
8 EGO	CONTRIBUTIVES	12,6	1,5
	REQUESTED EC	18	0,1
11 MUL	CONTRIBUTIVES	4	0
	REQUESTED EC	12	0,9
Total Person Months	**CONTRIBUTIVES**	**68,8**	**1,83**
Total Person Months	**REQUESTED EC**	**48**	**0,99**
		116,8	**2,83**

WP 9: Outlook and perspectives

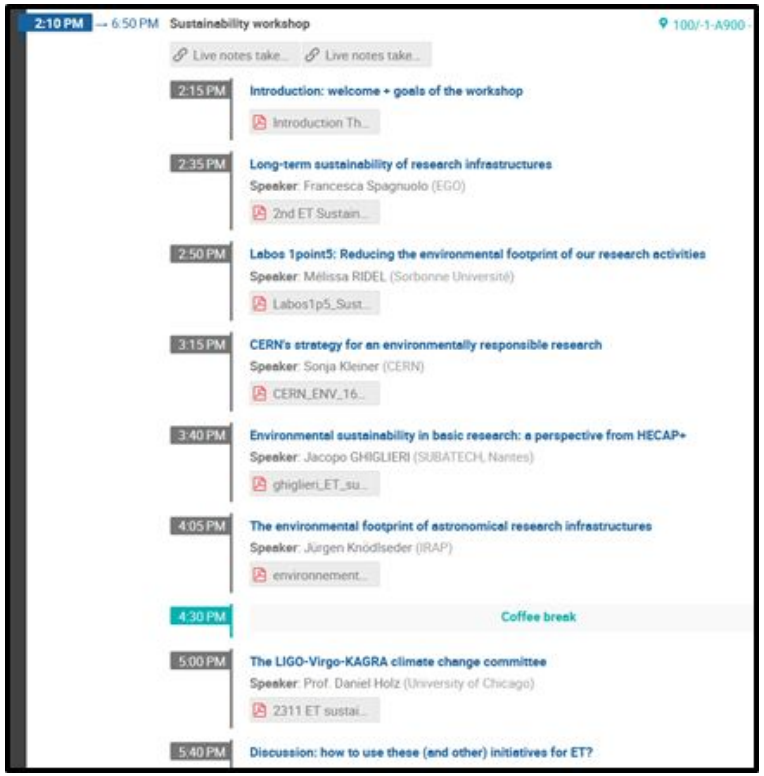
- A challenging first year to start coordination and involve people
- Situation improving in the second year of the project
  - WP (slowly) attracting more people
    - Francesca Spagnuolo (EGO), Florent Robinet (CNRS), etc.
  - Used the 2nd ET annual meeting to advertise the WP
    - Issues, actions and difficulties
    - In particular: organization of a dedicated one-day workshop next to the ET annual meeting – see next slide
  - Work has started on the 2024 WP products
    - Deliverables
      - 29/02/2024: ET Sustainable development implementation strategy
      - 31/08/2024: ET Environmental impact assessment and mitigation strategy
    - Milestone
      - 29/02/2024: ET sustainability workshop + report
        → All the material already available

→ Challenge: to keep the current momentum on a long timescale and to continue accreting more people

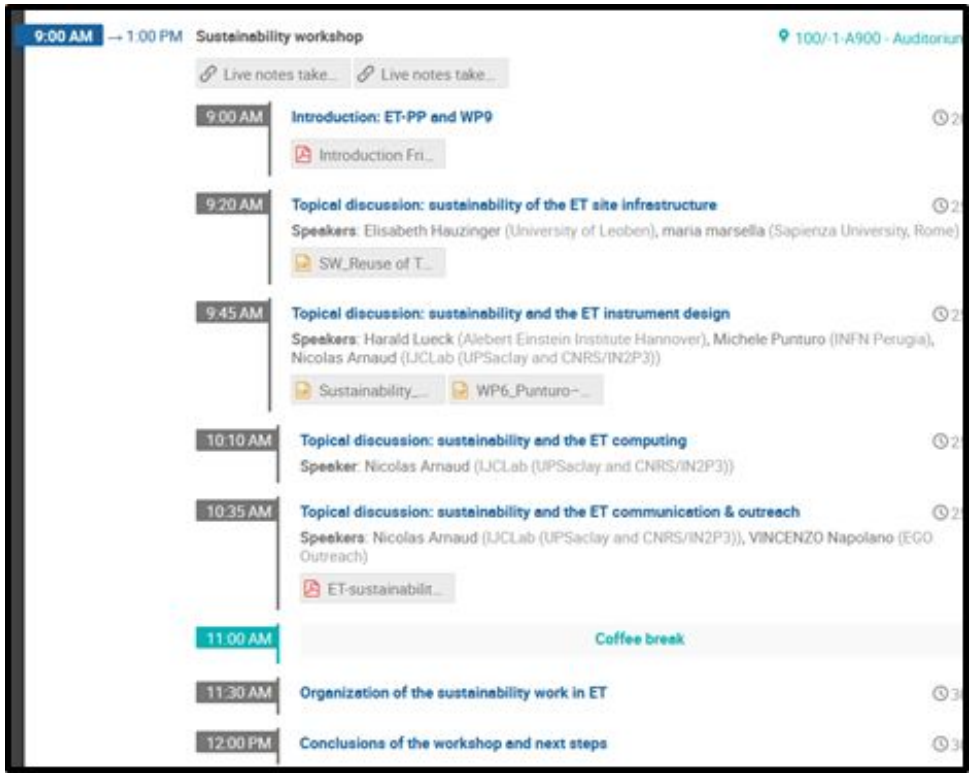
WP 9: Outlook and perspectives

- Sustainability workshop: https://indico.ijclab.in2p3.fr/event/9686/timetable/?view=standard
  - About 50 participants: half in person, half remotely
  - All talks available online – plus some live minutes not curated

- First half-day: external inputs



Second half-day: focus on sustainability for ET



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WP 9: MUL contribution to civil engineering

- Investigations of the underground
  - A wide range of methods

Geotechnical
UCS, Tensile Strength, CERCHAR Test Point Load, LCPC Test, …

Geochemical & Petrophysical
Eluate, water absorption, porosity & permeability, density, TOC, …

Mineralogical
XRD, XRF, ICP-MS, Optical Microscopy, FTIR, …

(Borehole-) Geophysics
Gamma-Gamma, SP, Dilatometer, Seismics, …

→ Geological characterisation

Classification of Subsurface		
Rock classification	**Mineral composition**	**Rock descriptions**
Very weak marl	-	Numerous, closed micro-fissures, low stiffness, ductile behaviour, swelling potential
Weak marl	Clay=45-60, quartz=15-30, calcareous minerals=20-30	Micro-crystalline quartz, medium-high plasticity, minor micro-fissures, swelling potential
Medium-weak marl	Clay=20-45, quartz=20-40, calcite=20-30	Well cemented, low plasticity
Weak sandstone	Clay=5-20, quartz=40-70, calcareous minerals=5-45, feldspar=5-10	Fine-grained, poorly cemented
Medium sandstone		Rare discontinuities
Strong sandstone		Better cemented, fewer discontinuities

- Strategies for the reuse of excavated material should at least meet the following requirements

Technical Feasibility

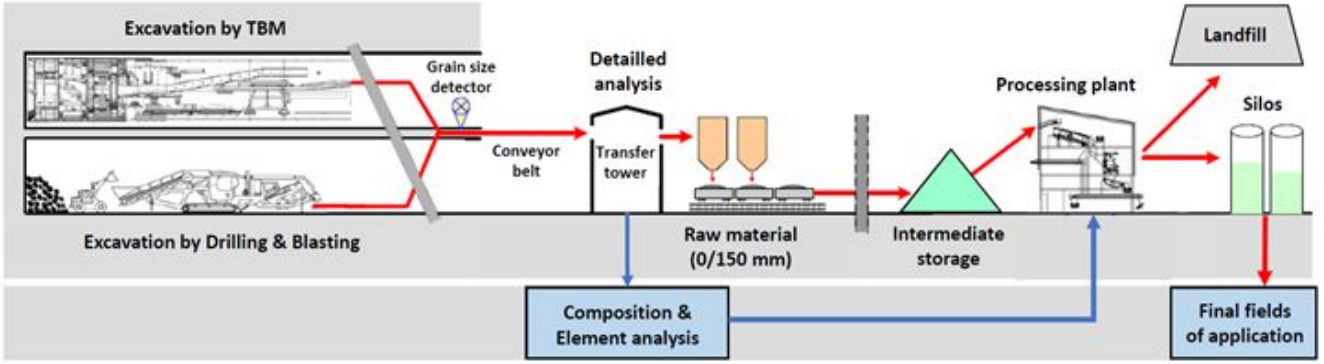
Economic Viability

Social Benefits

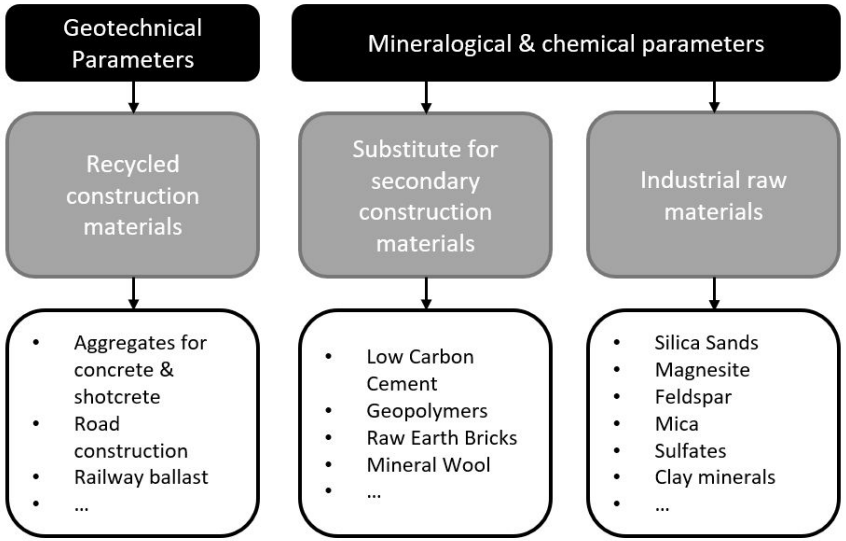
Project Relevance

WP 9: MUL contribution to civil engineering

- Real time characterisation of material
  - Onsite online-analyses on conveyors to detect impurities and pollutions as well as grain size
  - Sorted and classified material is processed further into respective products



- Many potential outlets for excavated materials



- Graphic representation of underlying forecast reliability and associated recovery and landfill classes of a tunneling project in phase A of the main investigations (ÖBV 2015)