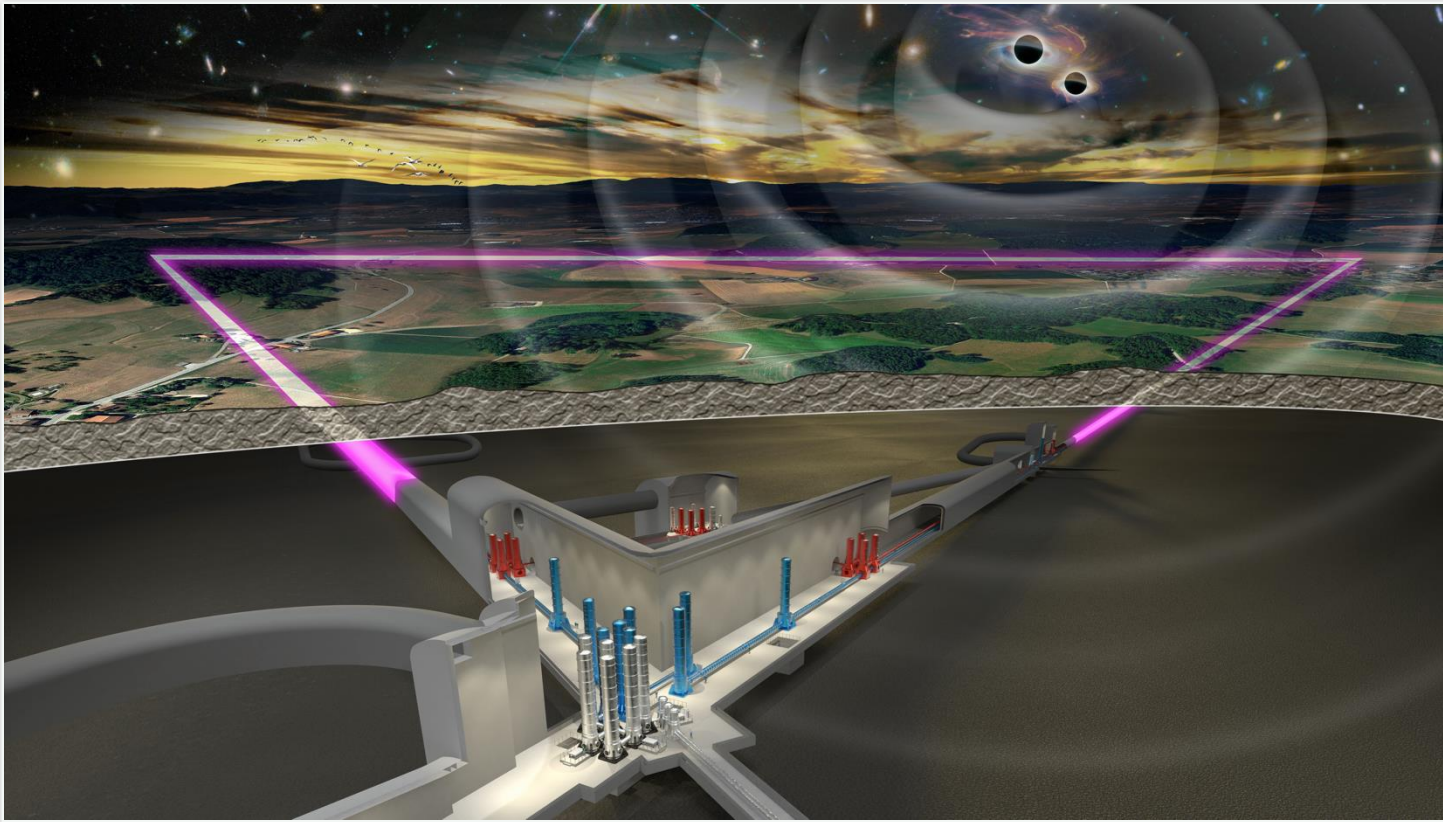




ET-EMR: TOWARDS ROBUST AND SUSTAINABLE FEASIBILITY OF ET HOSTING

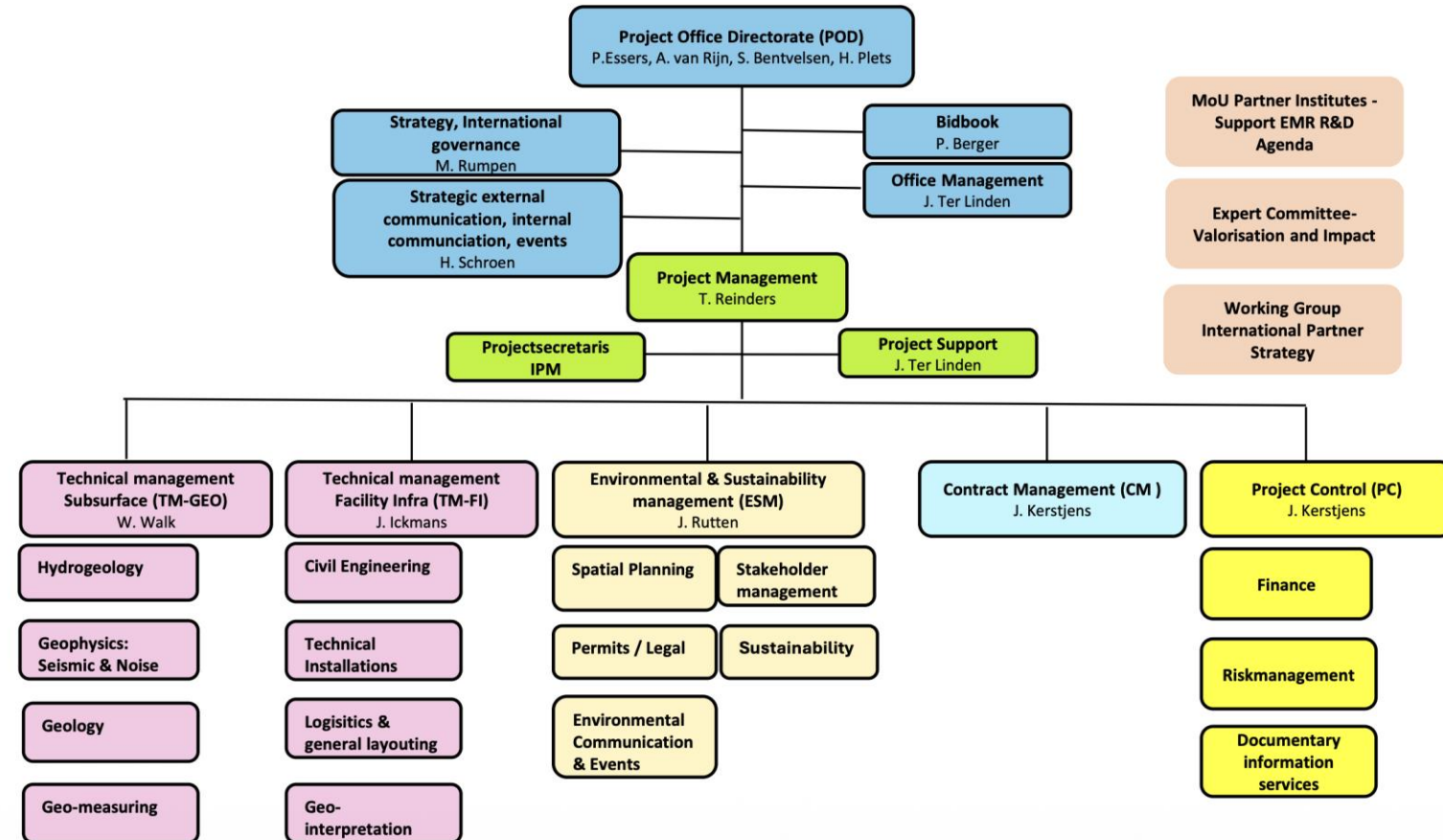
Stan Bentvelsen - Croatia, November 14, 2025
on behalf of EMR Project Office

Project Office EMR

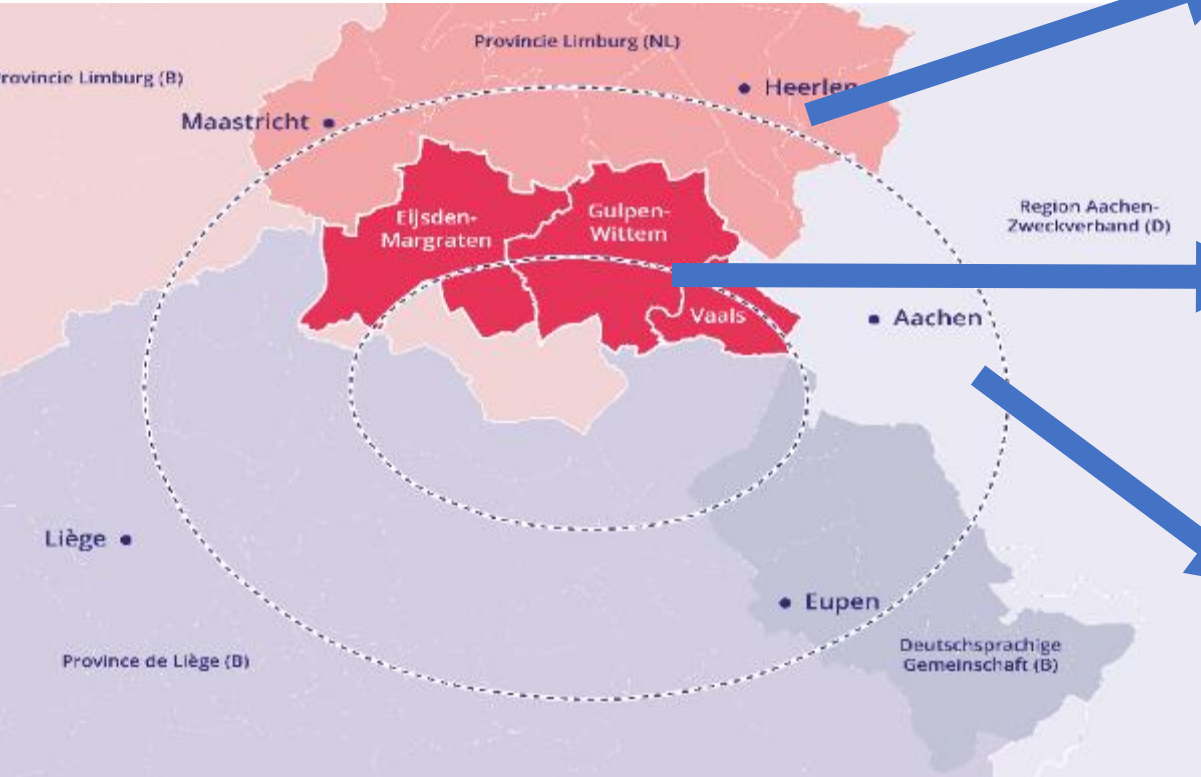
Installed by ministries of the participating countries



- Continuous support with changing governments



Commitments of the three countries



The Netherlands;

- *Feasibility:* NGF (23 M€) and Limburg (2 M€)
- *Construction:* reservation NGF (870 M€)

Belgium;

- *Feasibility:* VL, WAL and FED (12 M€)
- *Construction:* Flanders committed 500 M€
Wallonia 200M€

Germany;

- *Feasibility:* NRW (10,9 M€) and federal (1.1 M€)
- *Construction:* NRW commitment to co-finance
- German National Roadmap ongoing discussions

*In total more than 100 M€ for research and innovation projects in the three countries
e.g. recently additional 16 M€ for science, valorization and education in NL*

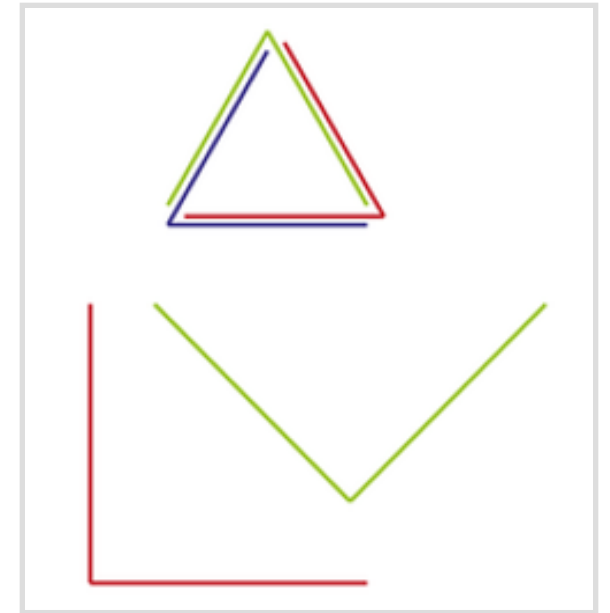
ET-EMR: geometry discussion

EMR proposal is based on constructing an unique infrastructure at a single site

- A centre of science- and technology activities: in high-tech environment
- A magnet for expertise, talent, innovations
- Satisfying the science requirements of ET

EMR current feasibility: focus on triangle

- Scientific performance in connection with null-stream
 - In-situ noise characterization/removal
 - Glitch identification and subtraction
 - Detector self-calibration
- Bring the community together at one site
- Risks concentrated on one location (incl. clear commitments host countries)
- Healthy economic return for a single site



L-shape studies so far as desk study

<https://journals.aps.org/prd/abstract/10.1103/l6tp-ykxp>
<https://arxiv.org/abs/2510.06327>

Subsurface

Triangle geometry 'MLT'

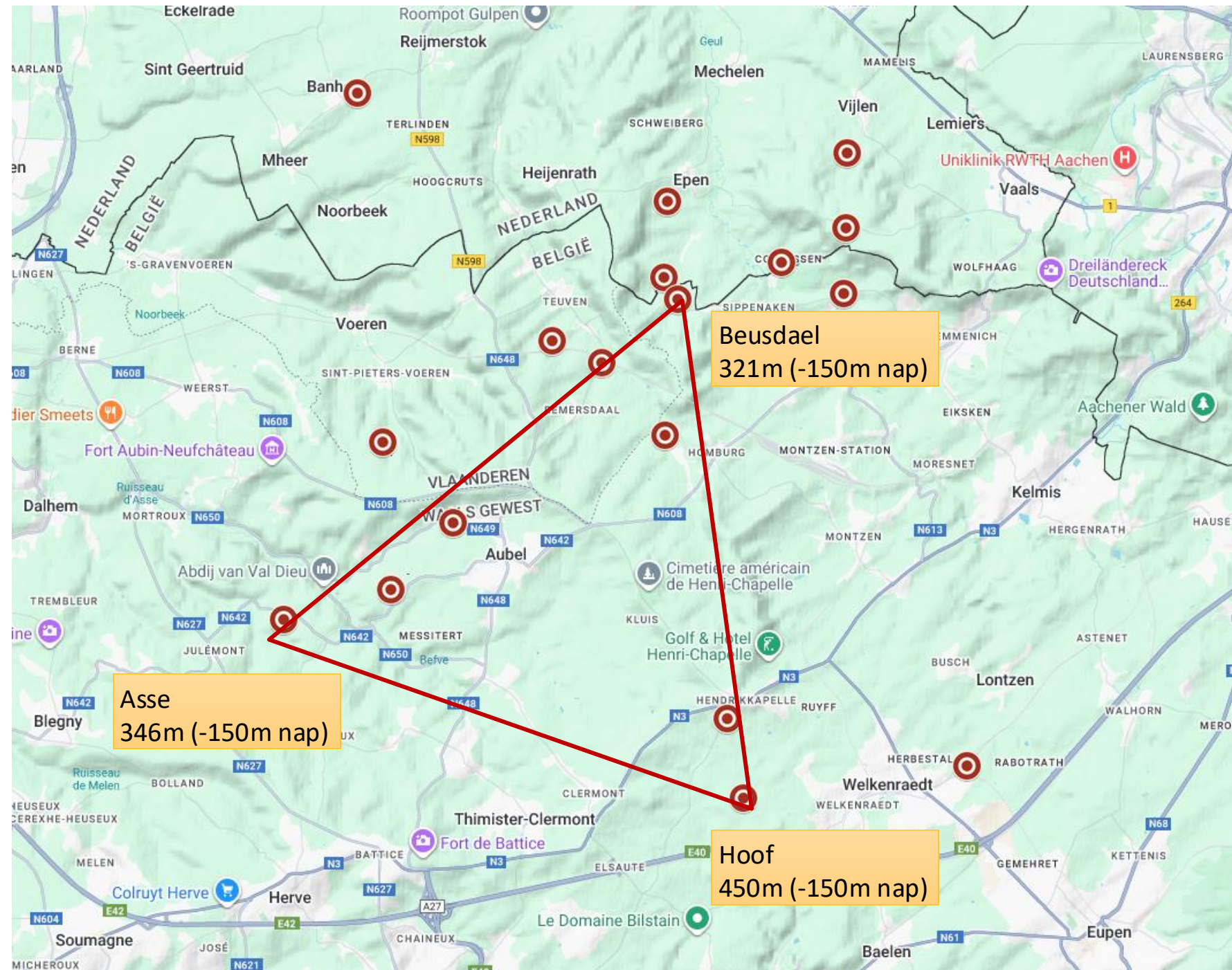
- Most promising tracé

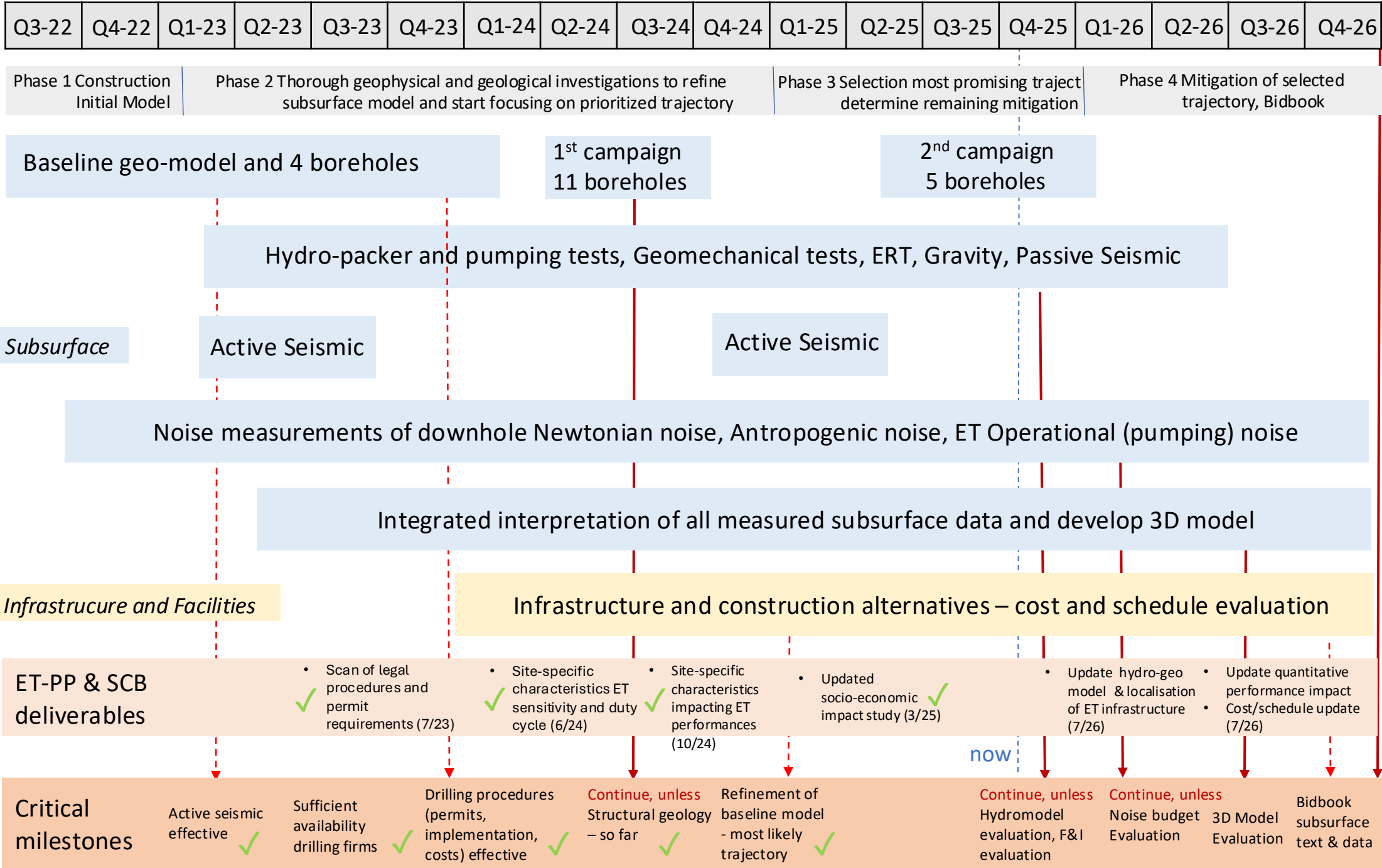
MLT Derisking:

- Structural Geology
- Geo-mechanical characterization

Planning

- We suffer some delays in installing subsurface sensors
- No impact on overall planning





Current
Timeline
EMR

Subsurface
activities
only

Schedule
does not
include
additional
work for L
layout



EINSTEIN
TELESCOPE

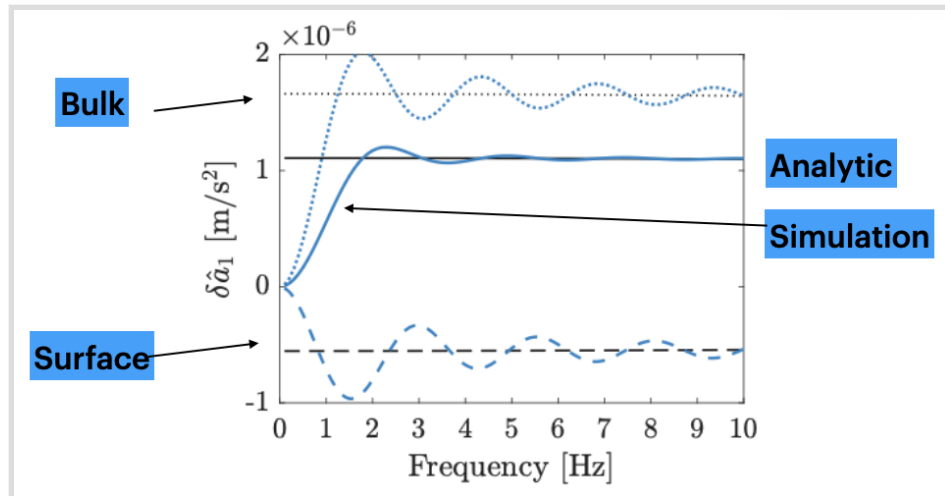
Tools for Newtonian Noise & mitigation

Evaluate the ongoing discussions on NN

- EMR demands, and develops, adequate noise modeling that suits the region
- ETC does currently do not have model of NN for complex geological settings

Agreement with ISB and SCB on development of tools for NN and mitigation

- The list of NN and mitigation modeling/design tools has been collected
- Reviewed and tested by July 2026

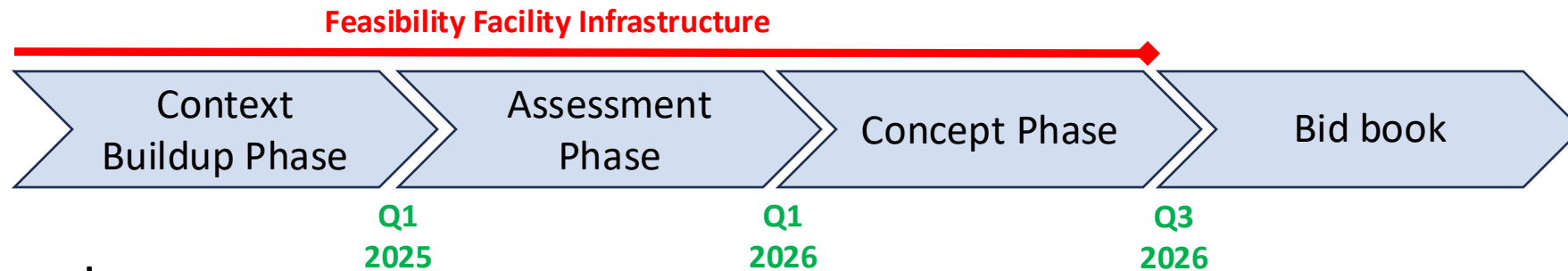


1. **Newtonian Noise optimizations** - Francesca Badaracco
2. **NewtonForge-3D** - Tomislav Andric
3. **SeisNN** - Andreas Rietbrock
4. **pySeis1DNN and pySeis3DNN** - Soumen Koley
5. **Prediction of environmental vibration due to anthropogenic sources and computation of Newtonian Noise** - Geert Degrande
6. **FraNC** - Tim Kuhlbusch
7. **ParaArrayOpt** - Johannes Erdmann



Subsurface Infrastructure

Well defined approach and timing



Three phases

- Context Buildup phase:
 - Determine showstoppers/cost drivers/risks -> priorities & mobilization teams
- Assessment phase: 2 parallel actions resulting in a basis for concept design:
 - Design concept scenarios (expert judgement) for the relevant disciplines
 - Converging design criteria together with ETO/ETC and other stakeholders (local)
- Concept design phase after fixation of main starting points
 - Finalize concept design & feasibility Facility Infrastructure and input bid book

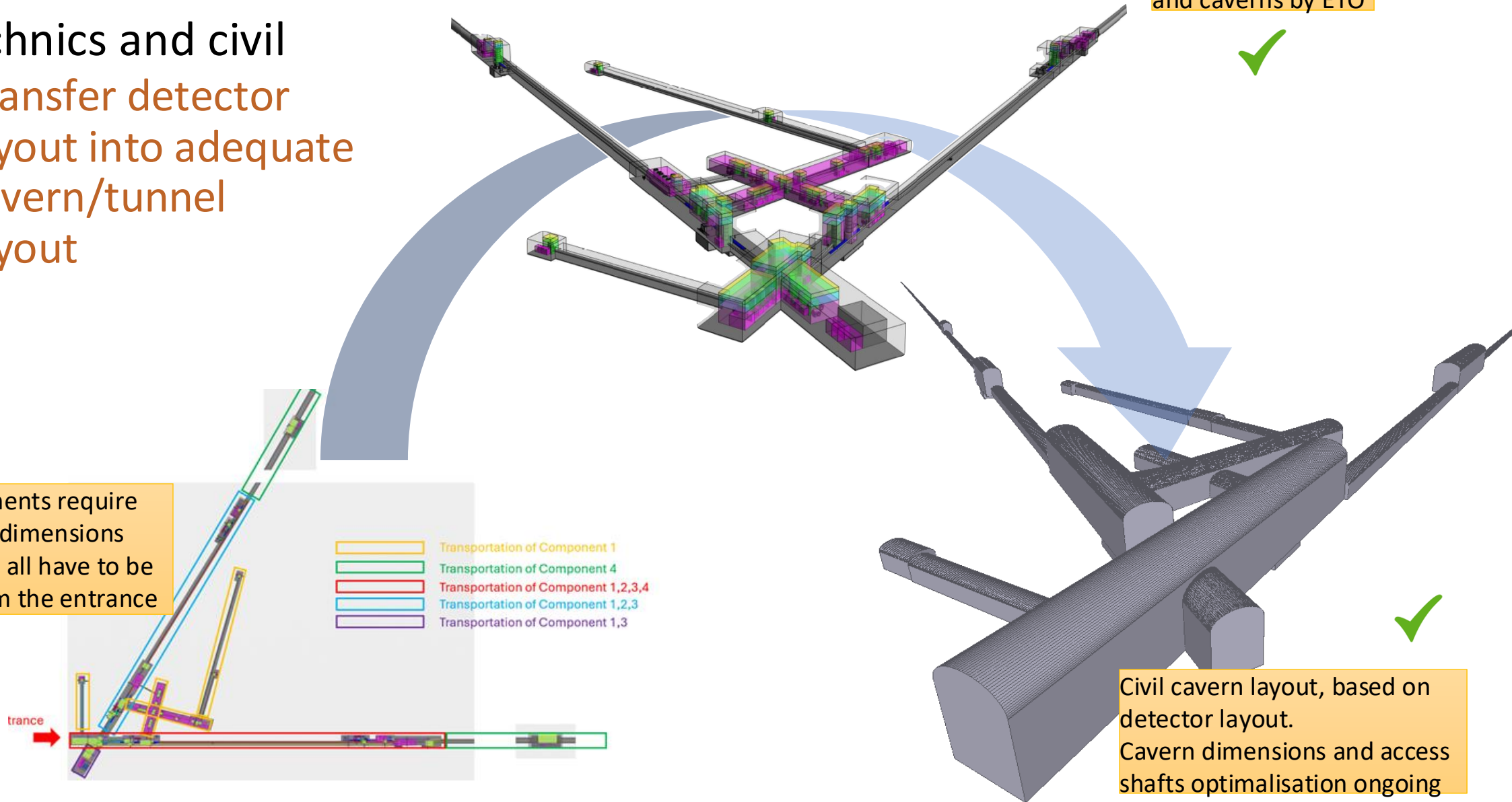
Subsurface Infrastructure

Geotechnics and civil

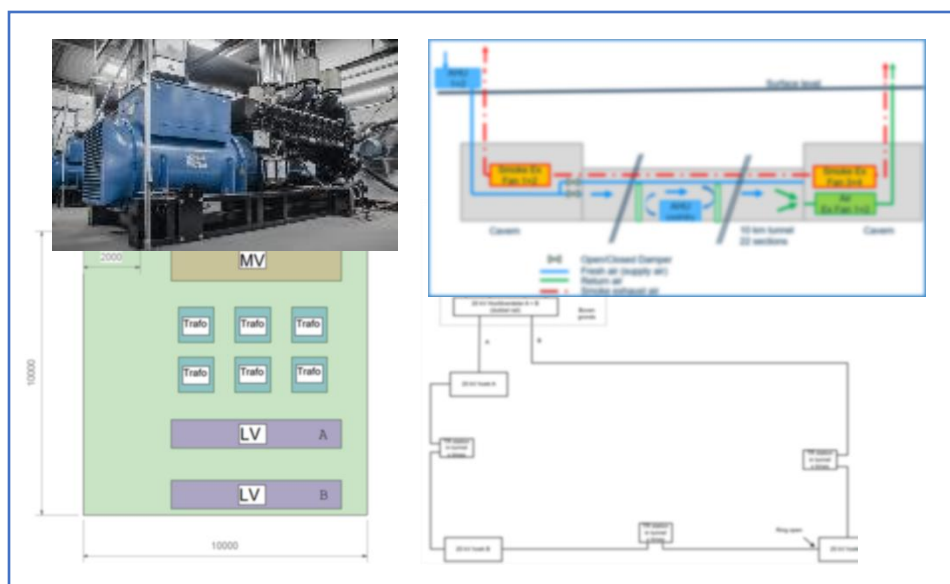
- Transfer detector layout into adequate cavern/tunnel layout

Logistics

Different components require special transport dimensions (size and weight), all have to be able to come from the entrance



Subsurface Infrastructure



Logistics

- ✓ • Establish access points
- Montzen translation
- 🕒 • Options for transport



Safety

- ✓ • Establish Safety concepts
- 🕒 • Connection to existing facilities and ETO

Technical Installations

- ✓ • Electrical demand and solutions with local providers
- ✓ • Determine ventilation concepts
- ✓ • Level for water ingress based on requirements
 - Dewatering determined to fulfill these requirements
- 🕒 • Noise budget and noise reducing measures

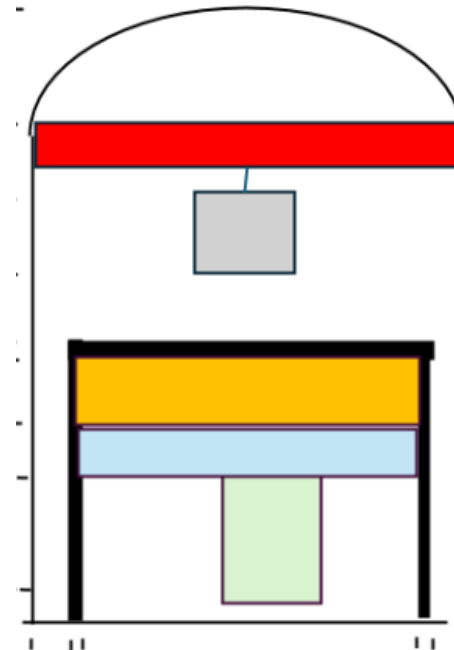
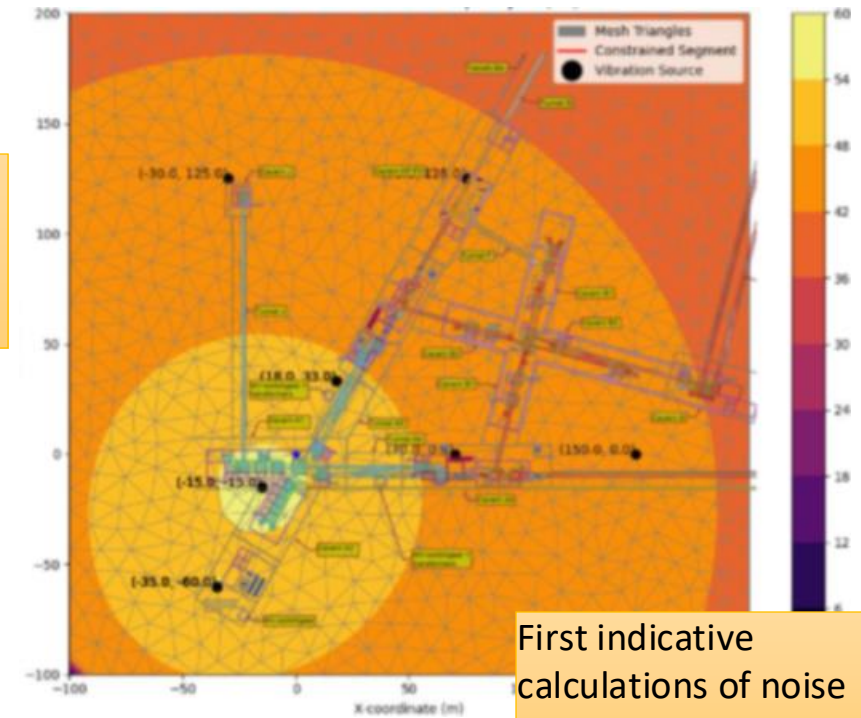


Subsurface Infrastructure

Significant impact on cavern sizes and costs. Deadline is end of 2025 in order to maintain planning

Next steps

- Further alignment on requirements and optimization
 - Hoisting systems & internal logistics
 - Efficiently managing subsoil environment conditions (temperature deviations, etc.)
 - Better define noise budget for underground equipment to not interfere with detector
 - Etc.
- Finalizing the assessment phase and startup concept phase
- Finalization of the feasibility for the hosting facility EMR + cost estimate



2 hoisting beams above each other necessary? Alternatives? Reductions in payload possible?

Environment, Sustainability and Stakeholdership

Integral approach

- Collect and assess the impact of interventions in the environment
- Evaluation via Environment / Sustainability Matrix

Developing vision :

- Complying to international, national, regional and local standards
- Avoiding risks & dealing with mitigation and compensating measurements
- Satisfying support in the local area and creating added value locally

Work Packages

Environment :

Hydrogeology
Landscape quality
Logistics
Air Emissions
Machine noise
Mobility
Biodiversity

Sustainability :

Resource recovery
Circularity of materials
Energy providing
Participative investigation

See e.g. presentation J. Rutten

Environment, Sustainability and Stakeholdership

Example: utilize railway emplacement Montzen

- Available space for infra logistics
 - Storage of materials and equipment, spare parts, working area, stock piles, etc.)
- Sufficient connection with underground
- Handling facilities onto the railway
- Transport direction Luik/Visé and NRW (D)



Discussion promising: confirmation of feasibility expect to converge soon



Environment, Sustainability and Stakeholdership

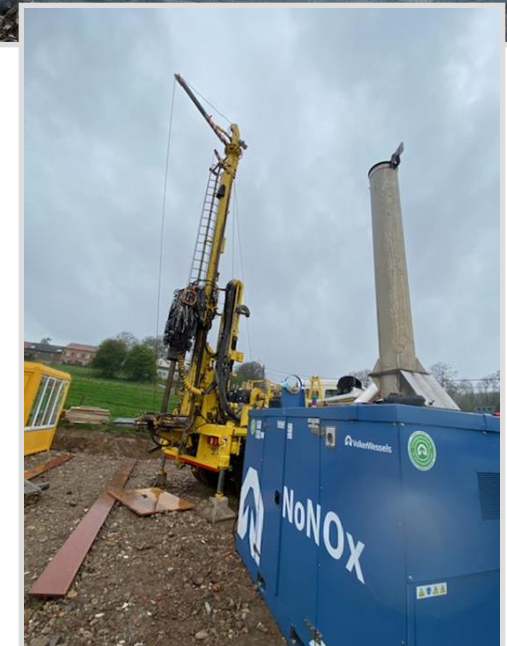
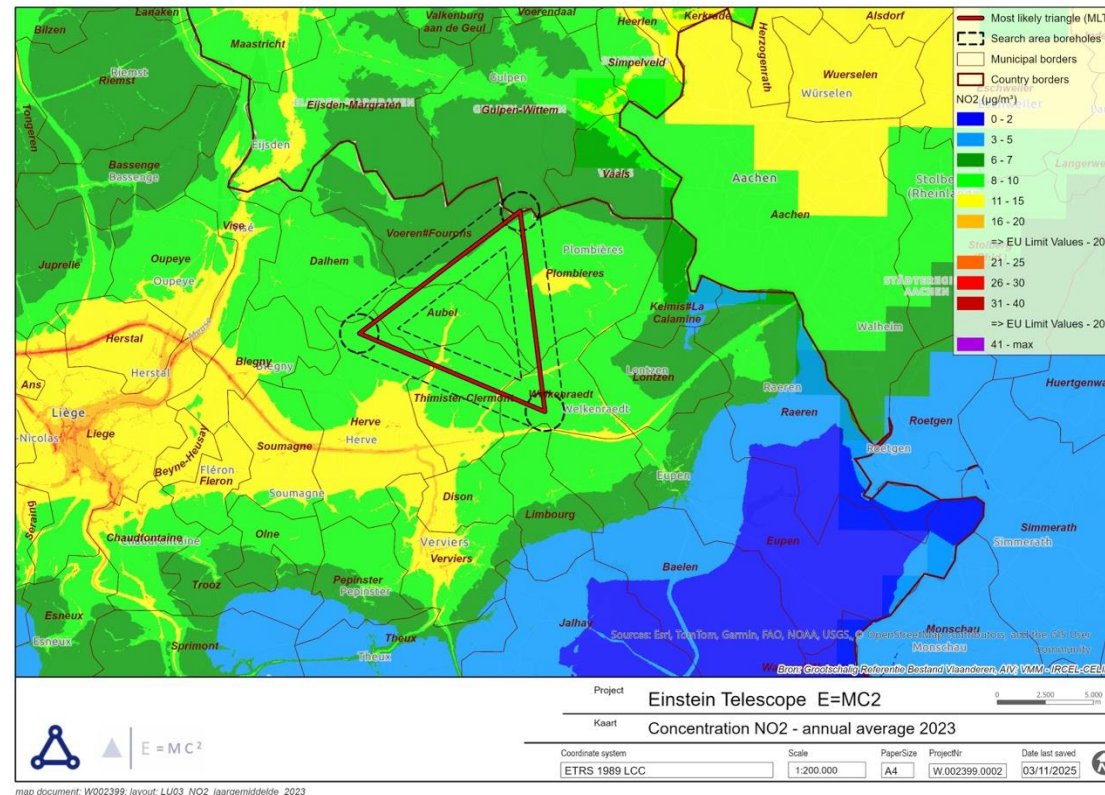
Air and noise quality

- Air emission sources : vehicles, generators, facilities,...
- Expected air emissions : NO_x, SO_x, NH₃, CO₂, etc.
- Assessing effects of deposition (f.i. impact Natura2000) and Carbon footprint

Machine noise :

- Construction phase
- Operational phase

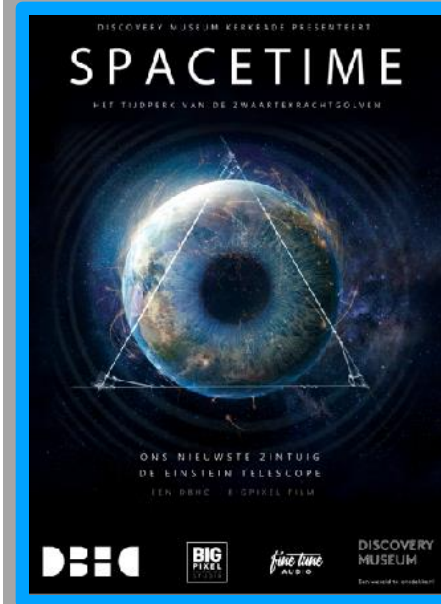
Comply with the
(most severe) legislation
and regulation standards



The Einstein Telescope Education Centre



- A full day programme on ET, specifically designed for school classes and their teachers.
- Collaboration between Maastricht University, Discovery Museum, Province of Limburg, and partners.
- Over 700 students have visited so far, budgeted for ~1500 more. Highly successfully polled!



Part 1: Watch Movie

Part 4:
Design your own presentation!

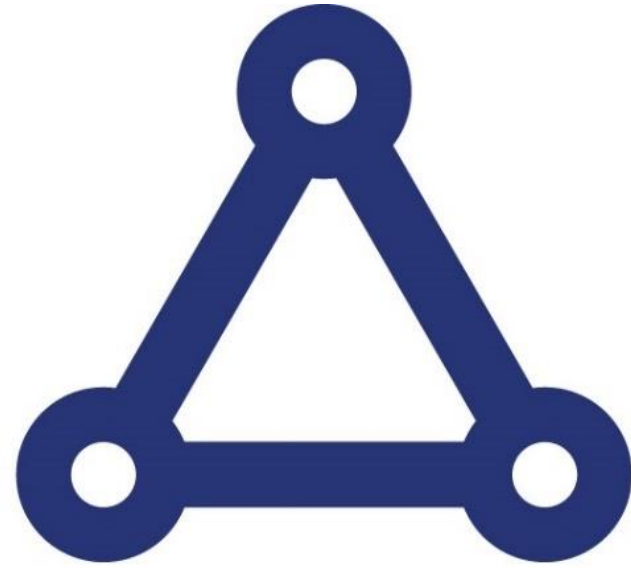


Part 2:
Follow interactive lecture



Part 3:
Do workshops





Einstein
Telescope