

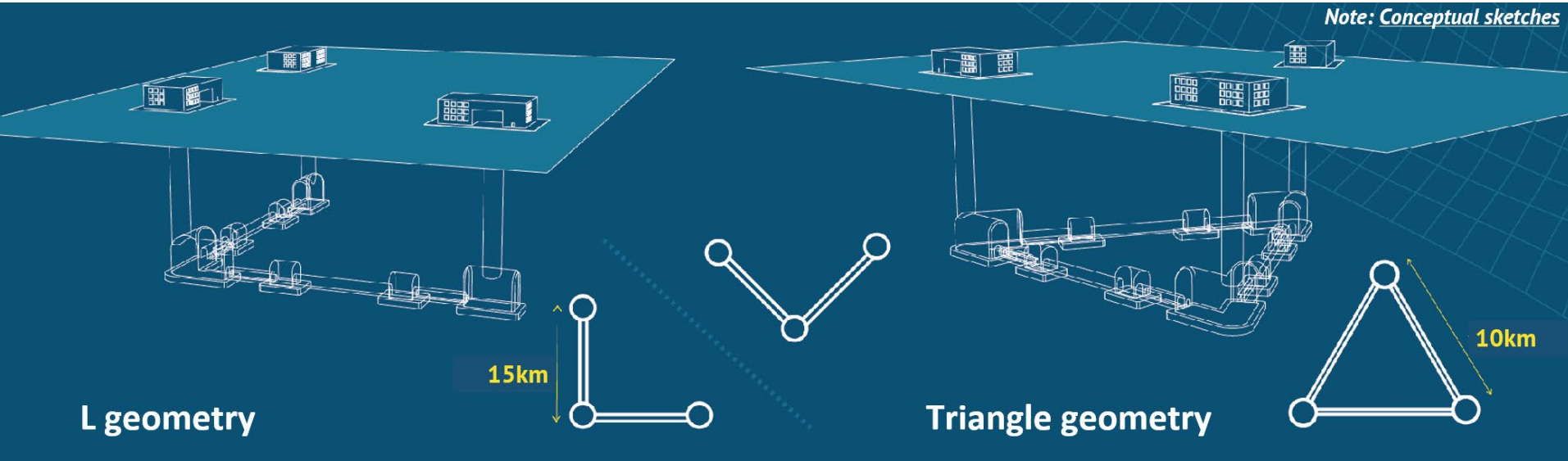


Civil Engineering Challenges of the Einstein Telescope Project

Tamara Bud – CERN

30th September 2026

Baseline Concept



Scientific Requirements

Driving requirement will be the detector sensitivity to:

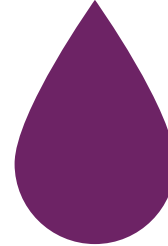
Geometrical
precision



Newtonian
noise



Hydrogeological
stability



Thermal
variation



Civil Design Drivers

Geometrical
precision



Ground
deformation
monitoring/control

Newtonian
noise



Facility 300m
underground

Hydrogeological
stability



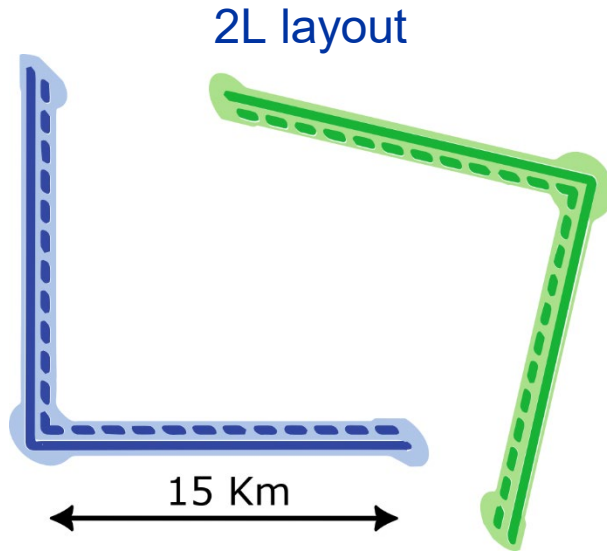
Drainage &
waterproofing
integrated lining design

Thermal
variation

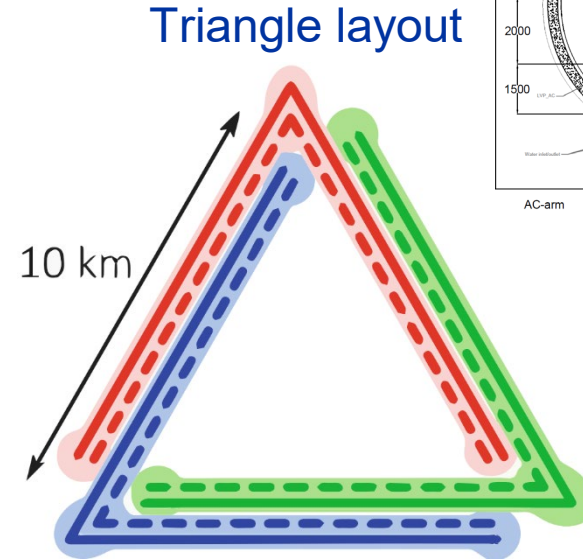


Ventilation &
environmental
controls

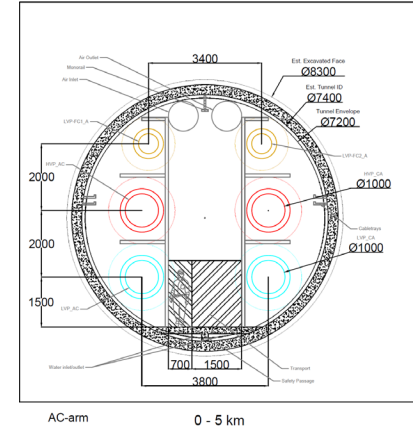
Site Independent Design



- TBM excavated
- 6.2 m circular cross-section



- TBM excavated
- 7.4m circular cross-section



Excavated Volumes

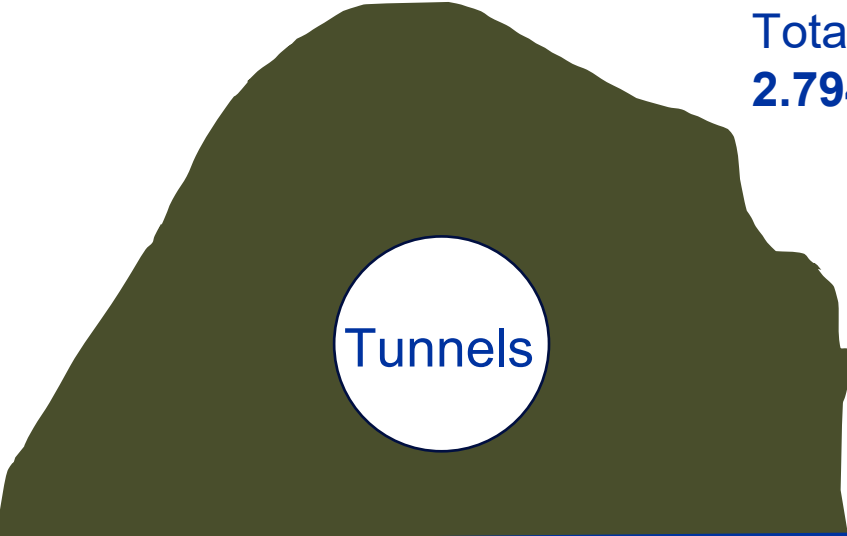
TBM Share: **54.4 %**

TBM tunnels: **1.521
million m³**

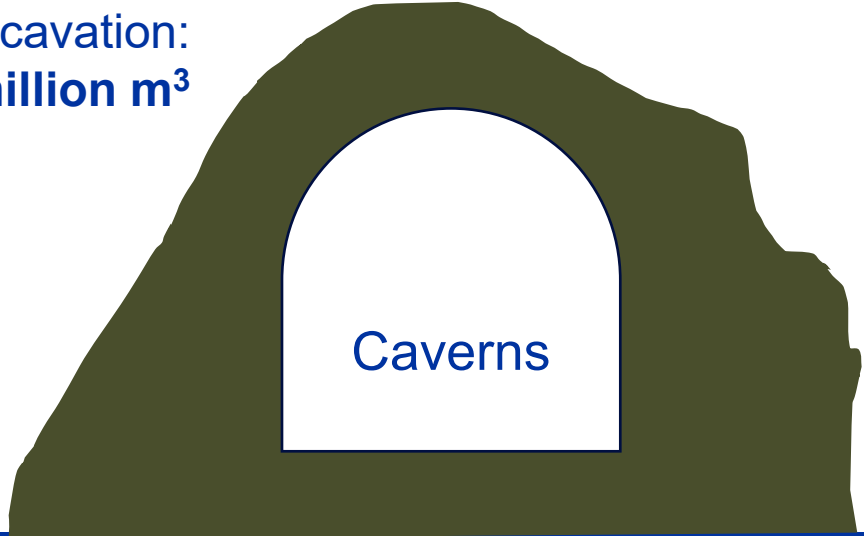
Cavern Share: **36.6 %**

Caverns: **1.023
million m³**

Total excavation:
2.794 million m³



Tunnels



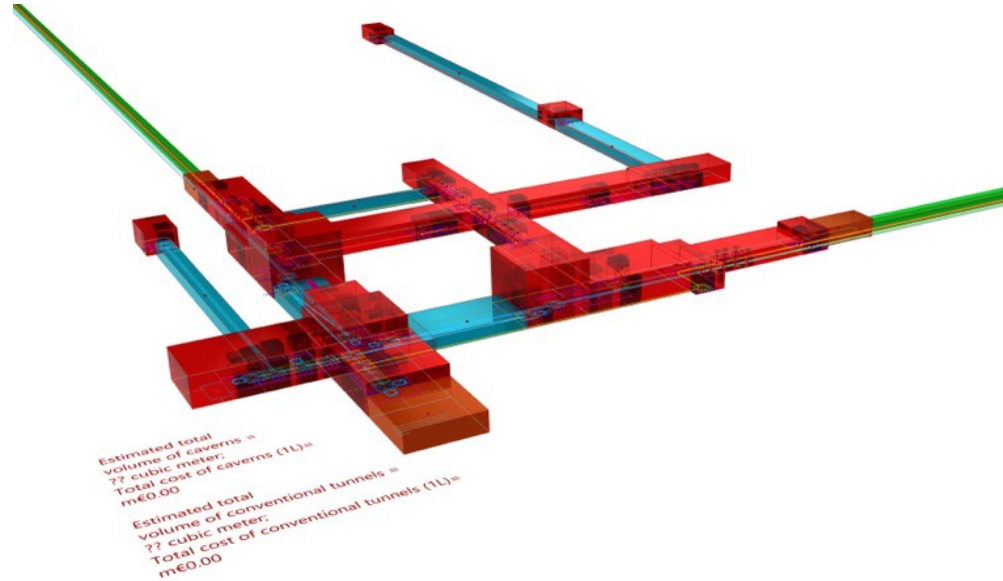
Caverns

Parametric Design

Parametric design automatically generates geometric envelope without fully developed optical layout

Model generates enclosing volume adapting to evolving optical layout

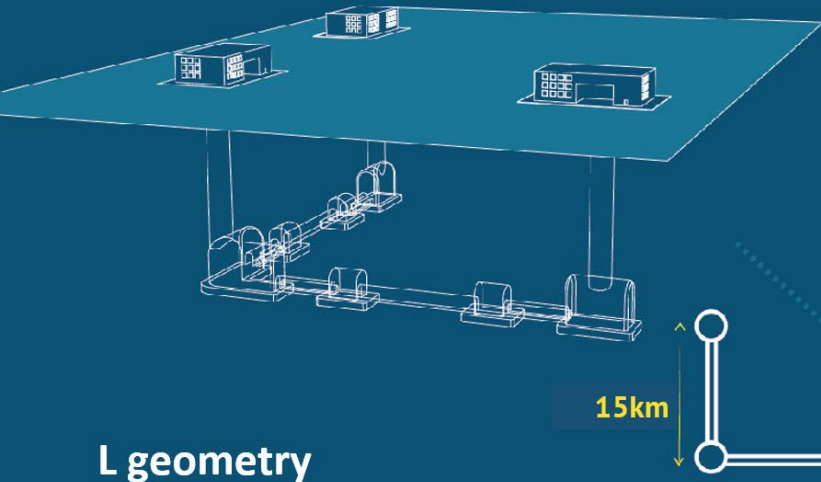
Based on 2D optical layout, with spatial constraints e.g. safety



Model for 2L configuration generated automatically from 2D drawings and input metric parameters

Einstein Telescope Siting

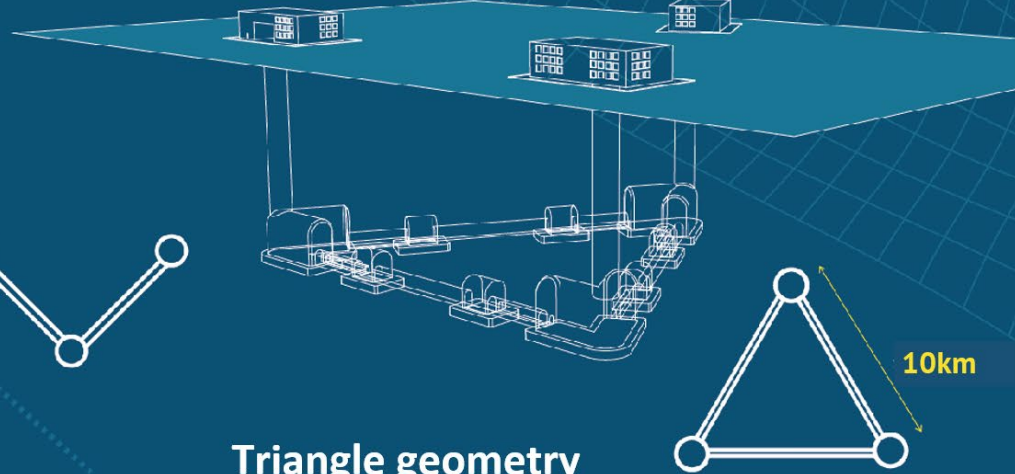
Note: Conceptual sketches



L geometry

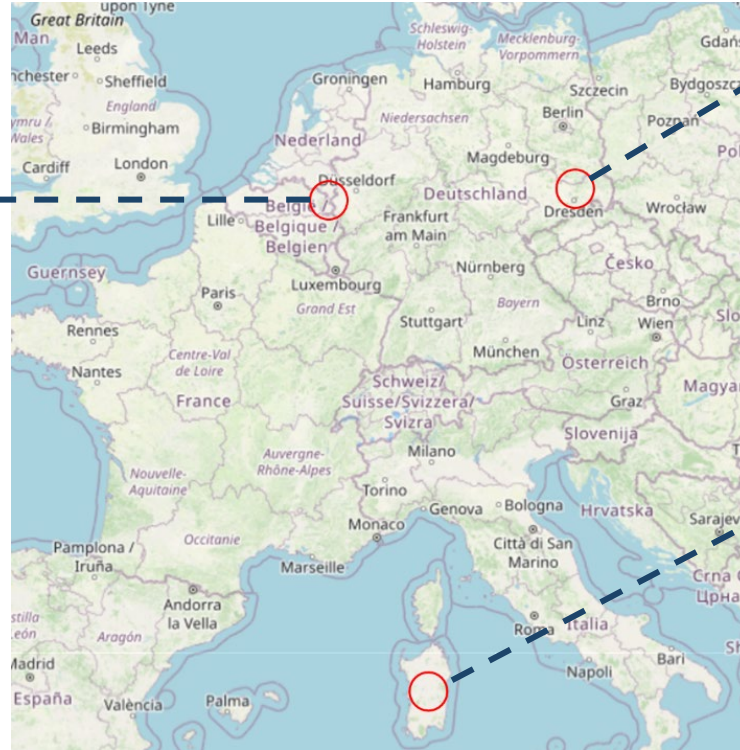


Triangle geometry



Site Specific Considerations

Euregio Meuse-Rhine
(EMR) Region
(Netherlands/Belgium
/Germany)



Lusatia (Germany)

Sardinia (Italy)

Site Specific Information - EMR

Sand/claystone &
soft chalk



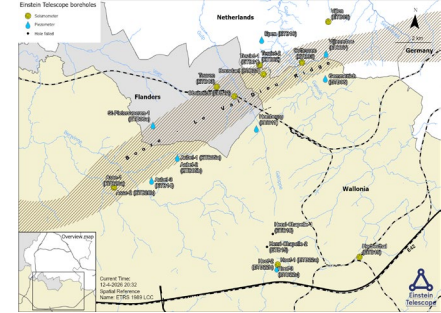
Shale



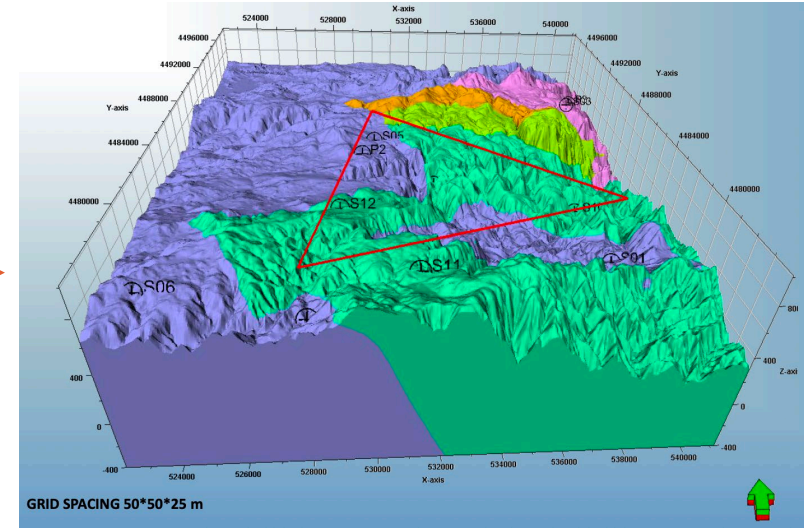
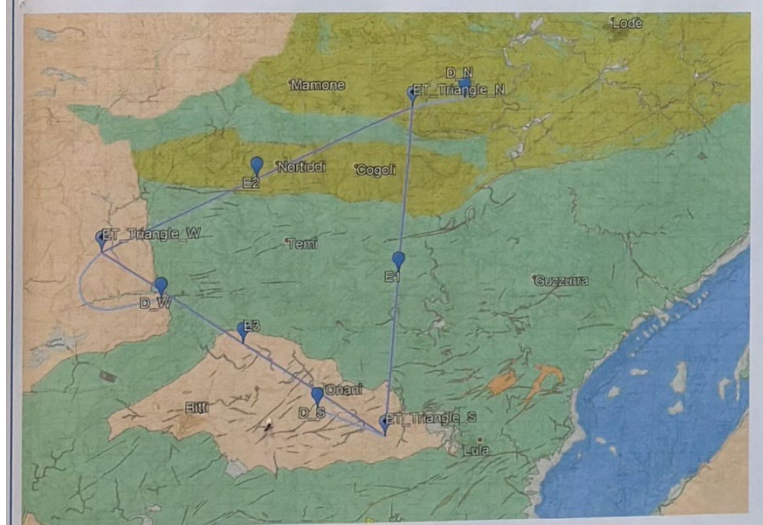
Limestone



Silt/Sandstones



Site Specific Information– Sardinia

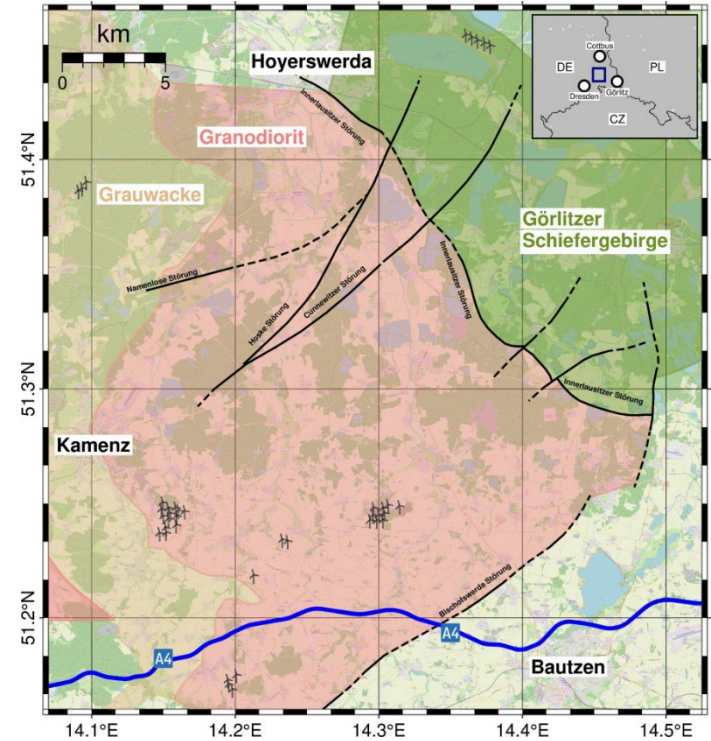
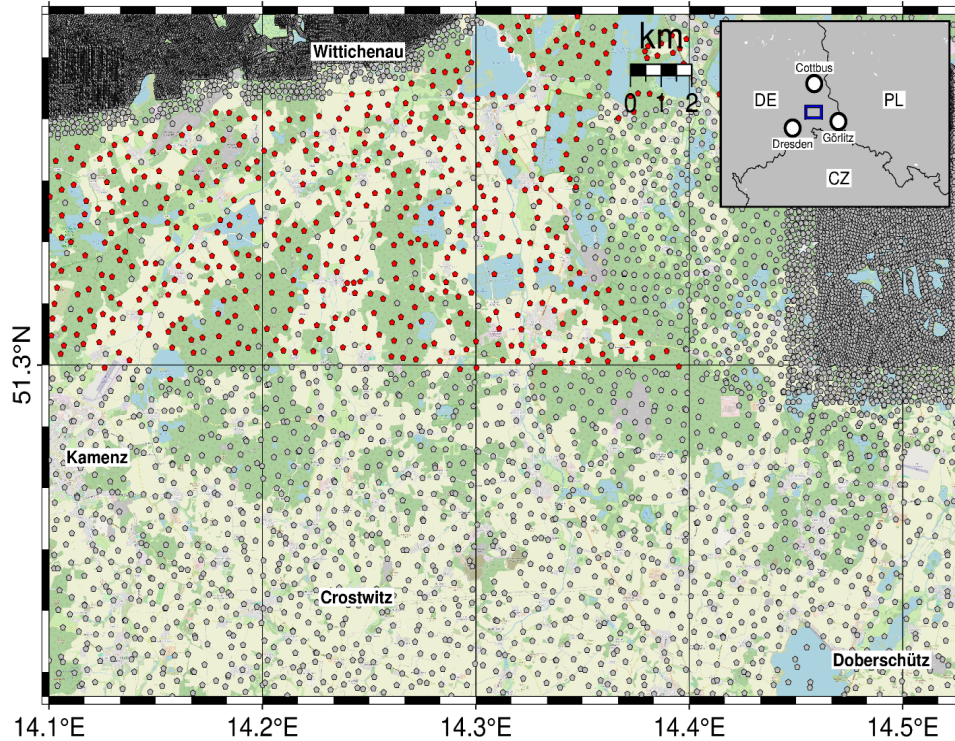


This model provides an advanced digital tool for supporting:

- ☐ subsurface geological management,
- ☐ the minimisation of geotechnical risks,
- ☐ the definition of construction strategies,
- ☐ the implementation of scenario-based design analyses

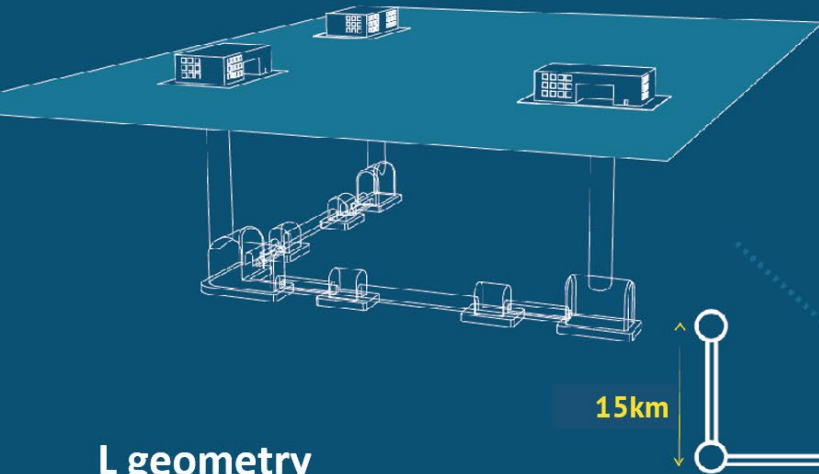


Site Specific Information– Lusatia (Germany)



Cost and Operation

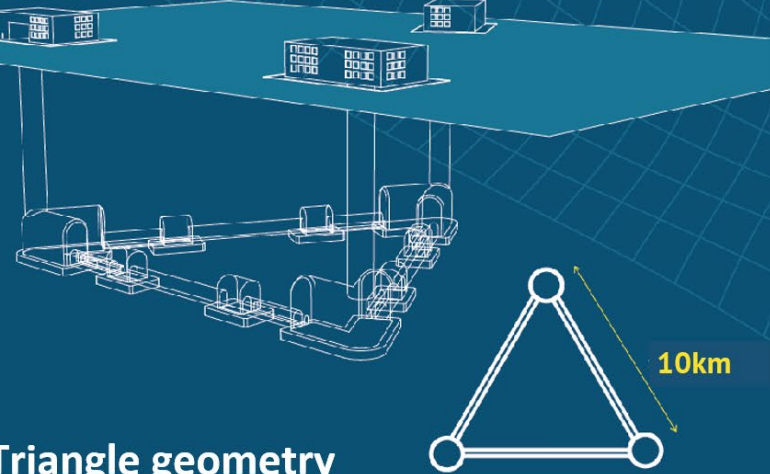
Note: Conceptual sketches



L geometry

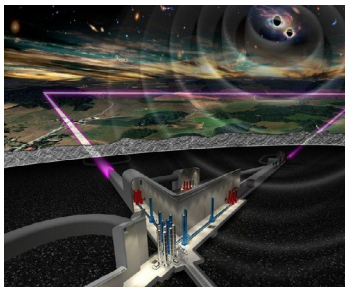


Triangle geometry

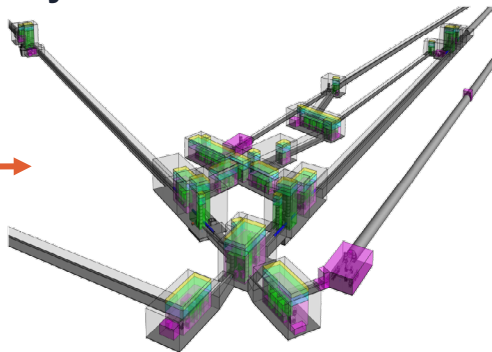


Cost and Timeline Estimates

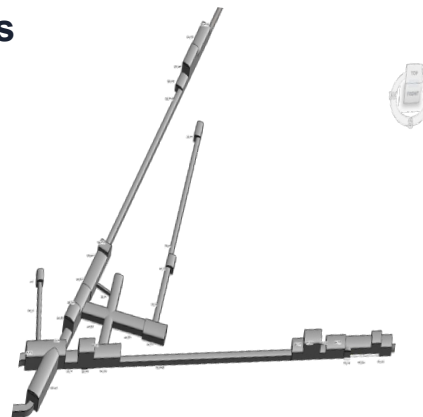
2020: ET Design Update



2024: Preliminary layouts



2025: Baseline layouts



Q4 2026

Q3 2027

2030s

Open call
for tenders

Site selection
decision

Construction
projected to begin in
2030s

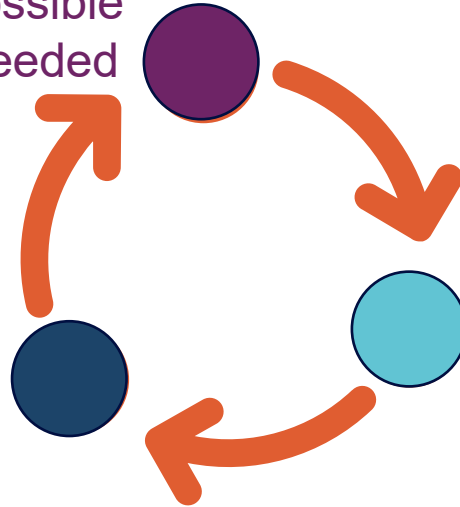
Operation & Lifecycle

Plan:

- **Carbon management** from outset with targets for reduction
- **Automated solutions** where possible
- Consider **Long Shutdowns** if needed

Maintenance:

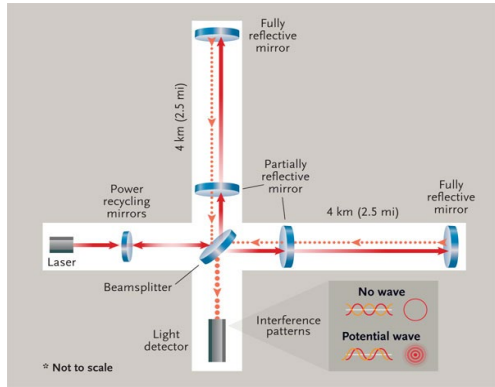
- Monitor **carbon reduction** and **report on improvements**
- Maintenance from digital tools (**automated inspections**)
- **Manual upgrade/repairs** during **predefined fixed periods**



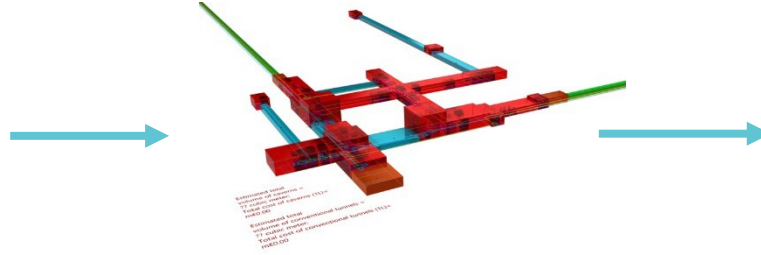
Operation:

- Create & execute strategy to reach **carbon reduction targets**
- Ensure digital tools mirror reality (**Digital twin**)
- **Minimise in-person** interventions during operation

Conclusion



Scientific Drivers



Parametric Design



Operation & Maintenance

Thank you for your attention!

