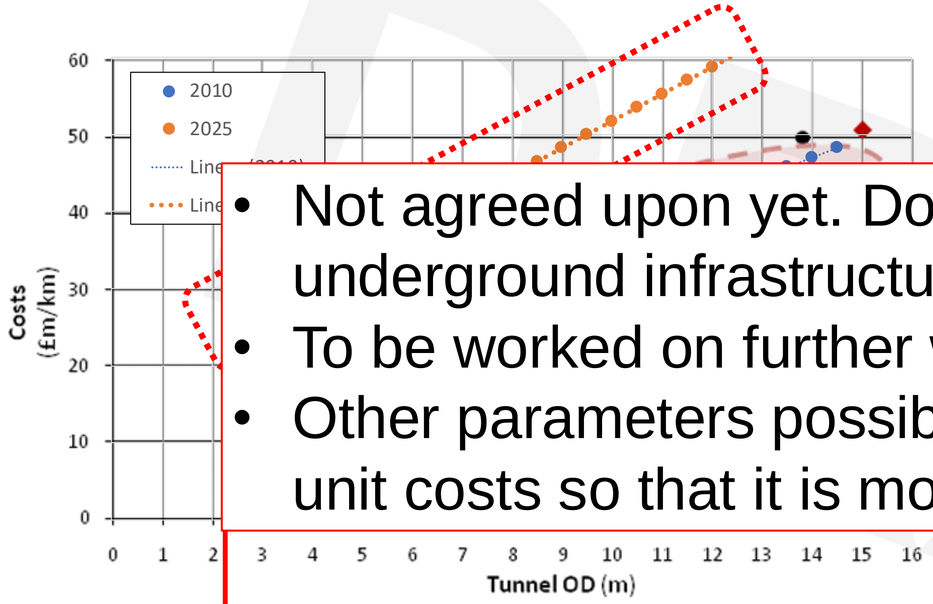
Summary of 1st CE session – 19 Feb 2025

Unit Costs for ETO Task Force Purposes

Chart G.1: The effects of tunnel outside diameter on unit costs



Source: Infrastructure UK Cost Questionnaires and British Tunnelling Society

- Not agreed upon yet. Do not take these numbers as what ET underground infrastructure will cost.
- To be worked on further with feedback from local teams
- Other parameters possibly to be included for calculating the unit costs so that it is more accurate

Caverns						
Source	**Unit**	**Unit price**	**Year**	**Inflation to 2025**	**Unit price (2025)**	**Note**
CERN (FCC, based on LHC-HL) source 1	€/m3	€ 591.40	2018	25.50%	€ 742.21	Injection cavern
CERN (FCC, based on LHC-HL)					668.41	Experimental cavern
					723.82	Junction cavern
					750.00	

unit cost = €543.472,50/m
unit cost = €434.670,00/m
unit cost = €444.450,00/m
unit cost = €143.482,50/m

Diameter (m)	2010	2025
6	€ 27.0	€ 37.8
6.5	€ 28.3	€ 39.5
7	€ 29.5	€ 41.3
7.5	€ 30.8	€ 43.0
8	€ 32.0	€ 44.7
8.5	€ 33.3	€ 46.5
9	€ 34.5	€ 48.2
9.5	€ 35.8	€ 50.0
10	€ 37.0	€ 51.7
10.5	€ 38.3	€ 53.5
11	€ 39.5	€ 55.2
11.5	€ 40.8	€ 57.0
12	€ 42.0	€ 58.7
12.5	€ 43.3	€ 60.5
13	€ 44.5	€ 62.2

These assumptions are not verified by other parties. Do not take these numbers as absolute.

Implication of these unit costs on the “Current L Detector layout”

Cavern	Detector Layout Block Dimensions				Est. Excav. Vol. (m3)	Note	Unit cost (€/m)	Cost (€)
	Height (m)	Width (m)	Length (m)	Detector Layout (m3)				
A1	20.5	28	30	17,220.00	18,916.33		€ 472,908.33	€ 14,187,250.00
A2	18	21	39.172	14,807.02	16,378.00		€ 313,578.65	€ 12,283,503.00
A3	14	22	42.171	12,988.67	14,426.86		€ 256,577.89	€ 10,820,146.38
A4_1	27.2	27.328	22.671	18,223.80	20,261.39	6m BA CR	€ 670,285.60	€ 15,196,044.88
A4_2	18	27.328	49.245	24,223.81	26,368.23		€ 401,587.48	€ 19,776,175.50
A5_1	27.2	25	22.671					€ 34,196.48	€ 861,169.88
A5_2	18	25	49.245					€ 34,131.40	€ 9,595,395.38
LF-FC	8	16	37					€ 34,146.13	€ 2,909,386.50
B1	14	21.5	135.828					€ 13,148.41	€ 449,241.88
B2	14	21	57.226					€ 24,384.34	€ 2,087,958.13
B3	14	22.093	44					€ 34,127.18	€ 28,241,056.50
G	14	25	42.174					€ 67,764.07	€ 1,135,048.25
H	10	16.672	18.204					€ 67,764.07	€ 1,135,048.25
HF-FC	8	18	32					€ 34,131.38	€ 9,636,243.00
C1	12	20	30	7,200.00	8,164.17		€ 204,104.17	€ 6,123,125.00
C_X	6	15	22.8					€ 44,430.00	€ 15,051,639.96
D_X	27.2	21.5	21.572					€ 44,430.00	€ 37,022,674.83
E_X	17	25	30					€ 44,430.00	€ 617,533,902.90
F_X	6	16	41.672					€ 44,430.00	€ 662,454,987.69
C_Y	6	15	22.8						
D_Y	27.2	21.5	21.572						
E_Y	17	25	30						2,176,943.66
F_Y	6	16	41.672						**4,353,887.32**
I	10	19	40						
J	14	11	15.218						
K	8	11	20.5	1,804.00	2,207.67		€ 80,768.29	€ 1,655,750.00
			Vol (1L)	**308,601.75**	**343,594.72**			

Tunnel	Detector Layout Block Dimensions					Est. Excav. Vol. (m3)	Note	Unit cost (€/m)	Cost (€)
	Height (m)	Width (m)	Length (m)	Inner Diameter (m)	Detector Layout (m3)				
T-A2	6	12.079	25.0	-	1,811.85	2,135.06		€ 64,051.93	€ 1,601,298.24
T-A3	6	12.078	25.0	-	1,811.70	2,134.90		€ 64,047.01	€ 1,601,175.15
T-A4	6	19	34.8	-	3,970.51	4,551.84		€ 98,018.25	€ 3,413,877.50
T-A5	6	16.5	36.8	-	3,646.07	4,207.45		€ 85,682.11	€ 3,155,586.56
T-LFFC	-	-	4980.5	6.5	165,268.29	276,007.83	TBM	€ 46,180.00	€ 229,999,490.00

- Not agreed upon yet. Do not take these numbers as what ET underground infrastructure will cost.
- Qualitatively, the largest driver for the cost/volume of excavation (more prominently for the 2L), is the tunnels

Explanation of the estimated excavated volumes following the detector layout volume:

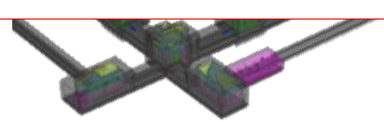
*further details on the assumptions (which could change) to be worked on

Caverns and manually excavated tunnels:

- Volume for lining and arch adds 15-20% to the volume.

TBM tunnels:

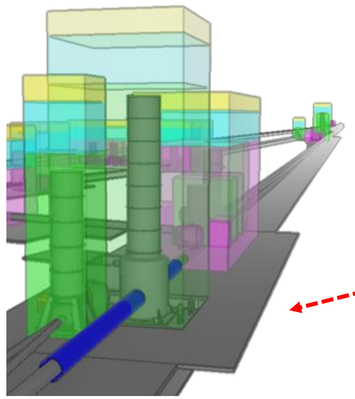
- Tunnel lining (0.3m), TBM steering deviation (0.5m), and gap (0.15m) added to the envelope to obtain the excavation face of the TBM tunnels.

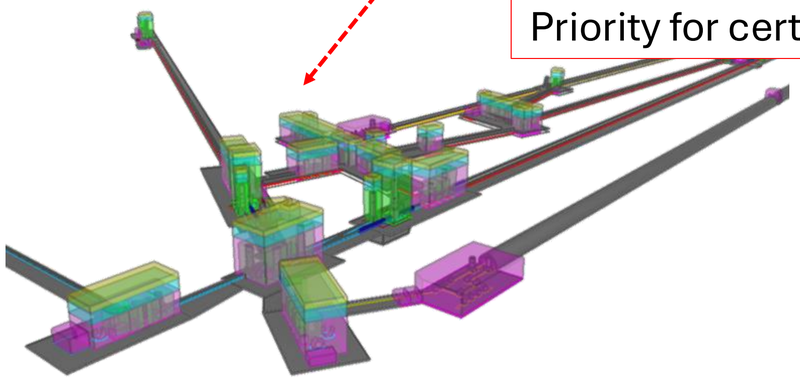


Cost of TBM tunnels = 82.79% of total excavation costs (L)
(66.78% for the triangle)

Note: these volumes are from Revit, a.k.a. detector layout that was shared through Trimble Connect

Detector Layout → Cost Estimation?





Civil infrastructure layout

- Tunnel,
- Caverns,
- Access shafts/tunnels
- Emergency exits, etc.

Target for Cost Estimation

- Mechanical systems
- Beampipes

Topic of discussion:
Aside from the tunnels and caverns housing the detector layout, what other requirements would also be cost driver?

This is not part of the task force mandate, but will be used by the local teams for the cost estimation done after the task force is done
Priority for certain questions that could have a large impact on costs

dependent cost estimation?
Issues:
n geographical and geological conditions
me geological/hydrological conditions to a

nning scheme(s) not considered
optimal cavern/tunnel shape
Assuming support system (primary and/or secondary lining, rockbolts, etc.)
ess (shaft/tunnel), nor depth/position

itional tunnels needed for construction
vice tunnels for excavation of caverns)
- Surface works not considered
- Technical infrastructure not considered
- Not fully considering safety (no personnel yet)
- ....

Discussion on needed requirements – interaction between science and engineering

- Water management
  - Water tightness of caverns/tunnels,
  - Allowable waterflow rate+type (e.g. laminar flow) for the context of newtonian noise (also for airflow)
  - Distance of pumps to towers (e.g. LF TMs)
  - Related to the required type of lining (and finishing) for certain/all caverns/tunnels
  - Allowable inclination of interferometer - ~1 ‰ (and 2‰) (but also most relevant for TM suspensions and at vertexes)?
- Environmental requirements
  - Humidity near LF/HF TMs, vertexes, arms
  - Temperature stability
  - Airflow
- Cleanroom requirements (electrical, airflow, etc.)
  - Noisy equipment location?
- Logistics -> implication on continuous cranes/caverns
  - What is the acceptable operational cost (e.g. time)?
- Needed recesses in tunnels (aside from safety)?
- Technical risk tolerance (e.g. shrinking tunnel envelopes and not leaving room for transport of certain tower bases in the future)
- …