

# FCC-ee civil engineering and infrastructure studies

## FCC Feasibility Study

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# FCC Civil Engineering

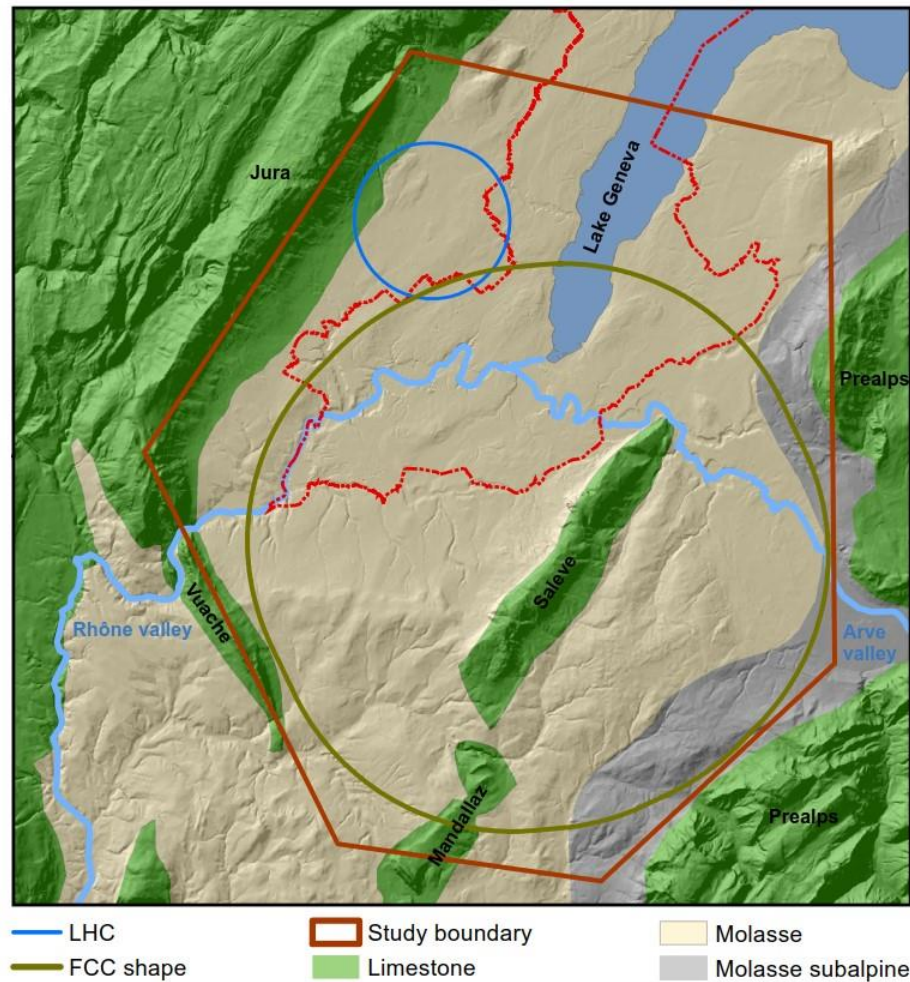
91.2 km tunnel

5.5 m internal diameter

Complex geology

Lake crossing

150 - 400 m deep



### Schéma géologique

(Au niveau du sol)

**Legend:**

- Molasse du Genevois et des Bornes (Light grey)
- Molasse charriée (Dark grey)
- Calcaire Jura-Salève (Yellow)
- Flysch des Voirons (Brown)
- Calcaire des Bornes (Light yellow)
- Fautes (Green lines)
- Surfaces de charriage (Dashed lines)
- Sillons morainiques (Dashed green lines)

## Molasse

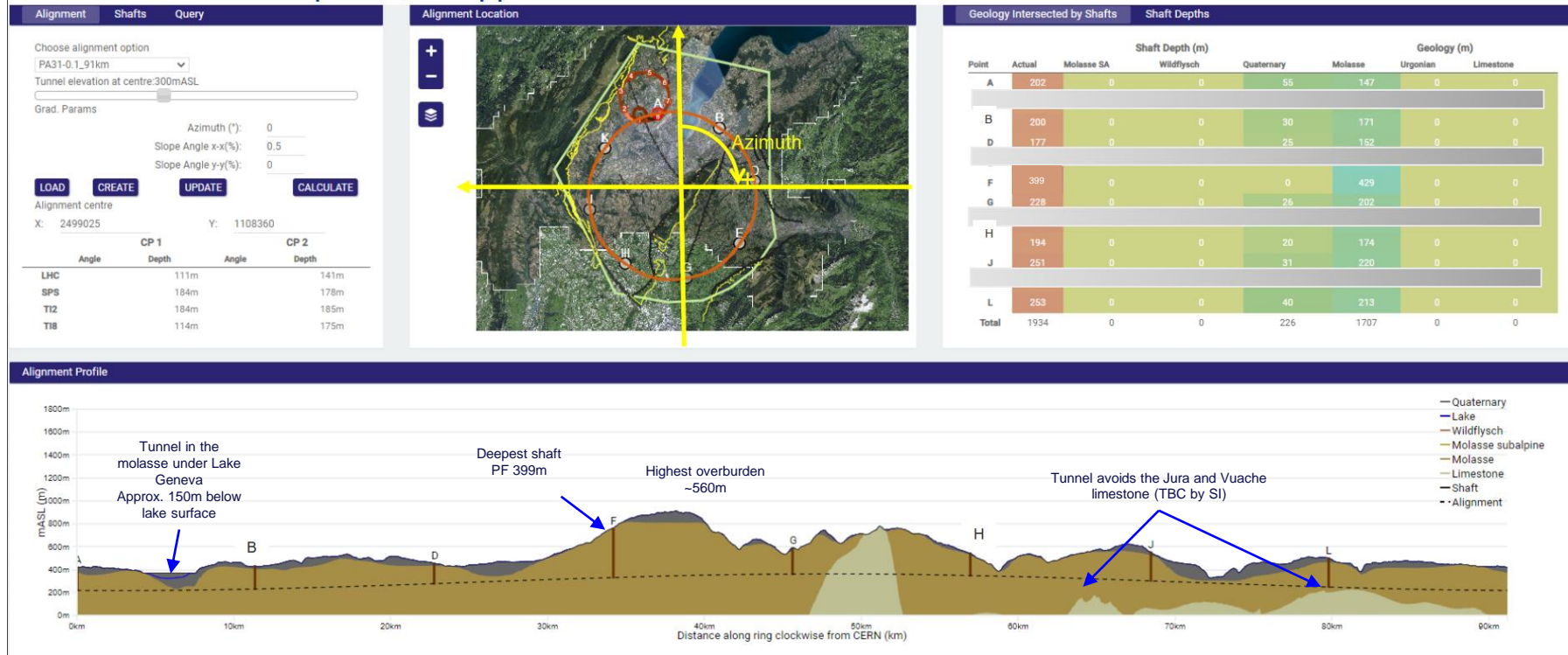
- Mixture of sandstones, marls and formations of intermediate composition
- Relatively weak rock (Average compressive strength: 5.5-48 Mpa)
- Considered good excavation rock
- Relatively dry and stable
- Faulting due to the redistribution of ground stresses
- Structural instability (swelling, creep, squeezing)

- Glacial deposits - gravel, sands silt and clay
- Water bearing

- Hard rock
- Normally considered as sound tunneling rock
- Fractures and karsts likely
- High inflow rates measured during LEP construction (600L/sec)
- Clay-silt sediments in water
- Rockmass instabilities

# Conclusions from the Placement Review Workshop

Selected scenario to be studied: **91km PA31-1.0 (8 points)**





# Areas of Geological Uncertainty

- Good knowledge of the ground (e.g. information from LEP/LHC projects)
- Good confidence - alignment in molasse

## Jura

- Limestone/molasse interface uncertain.
- Risk of karts and high water pressures

## Le Rhône

- Moraine/molasse interface not certain.
- Proximity to protected area

## Vuache

- Limestone/molasse interface not certain.
- Risk of karts and high water pressures
- Proximity to main active fault

## Les Usse

- Moraine/molasse interface not certain.
- Low tunnel rock cover

## Lac Léman

- Moraine/molasse interface uncertain
- Soils and rock properties uncertain
- High uncertainty in the hydrogeological conditions and water pressure

## Vallée de l'Arve

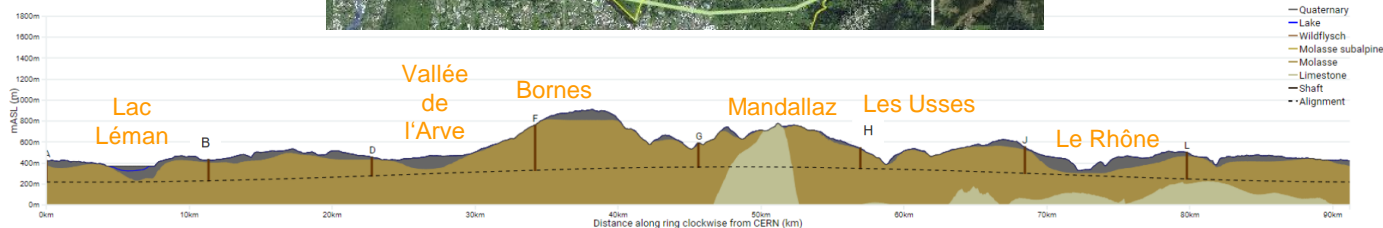
- Moraine/molasse interface uncertain.
- Lack of reliable boreholes

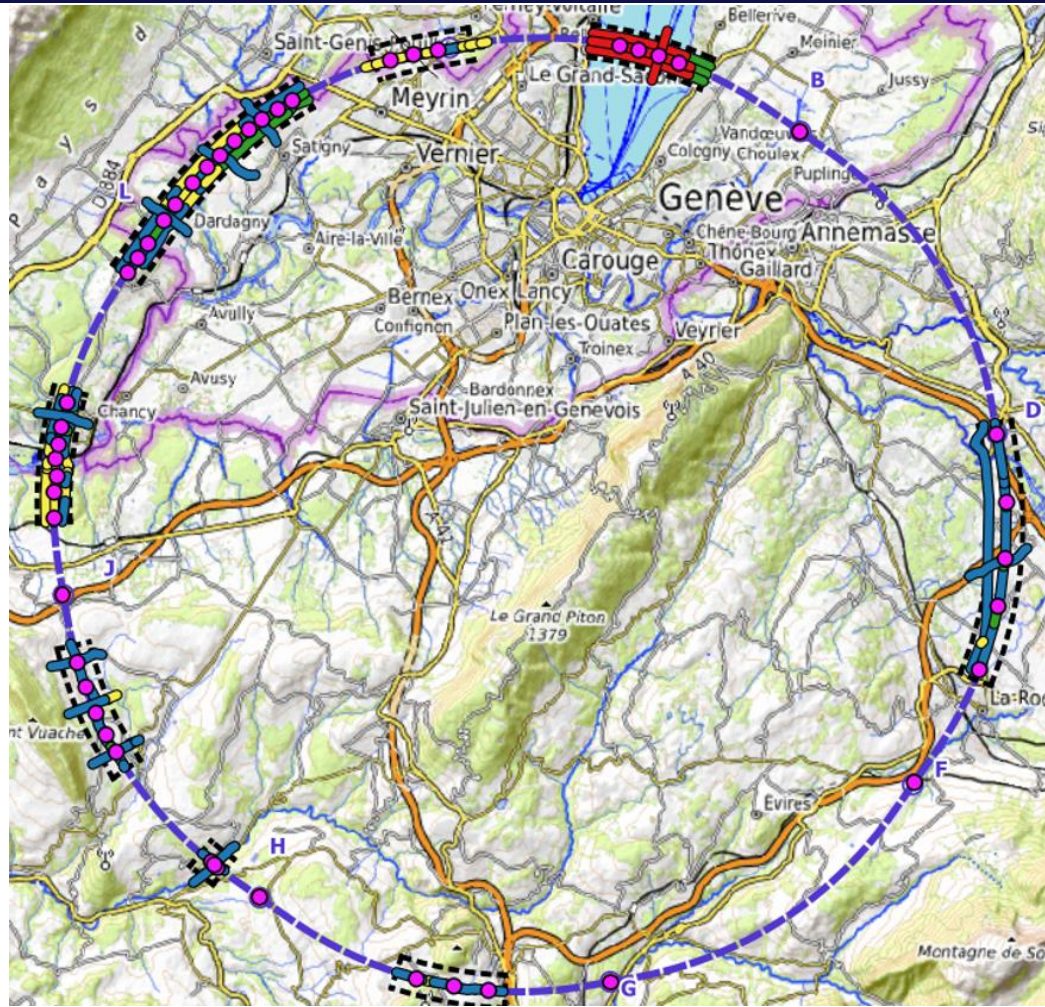
## Bornes

- Insufficient deep borehole information
- Complex faulted region, thrust zone.
- Quality of molasse is uncertain. High overburden.

## Mandallaz

- Fractured limestone formations, karst properties unknown.
- High water pressures

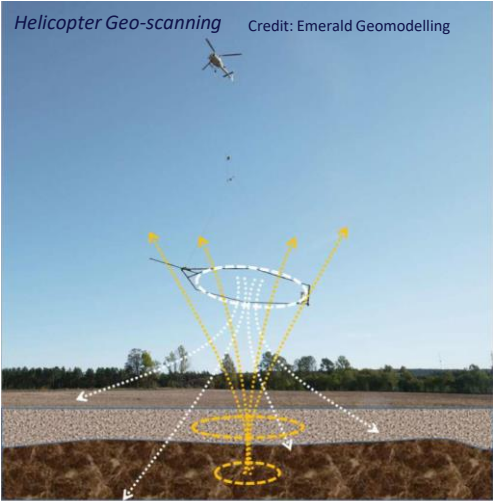
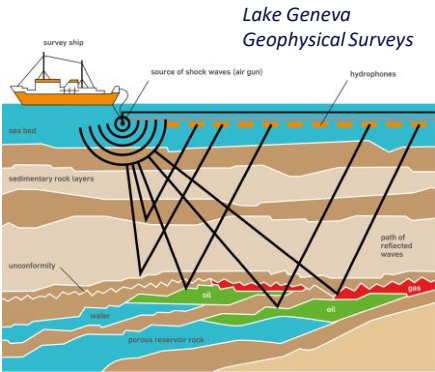




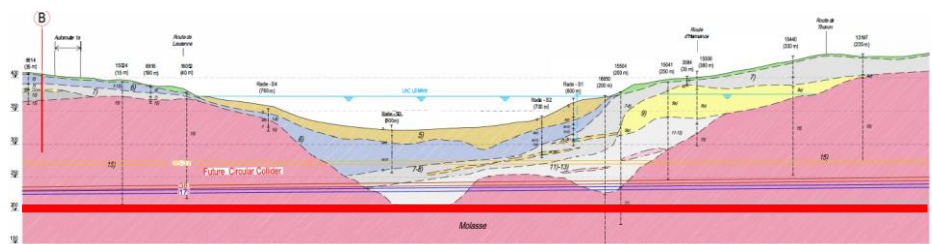
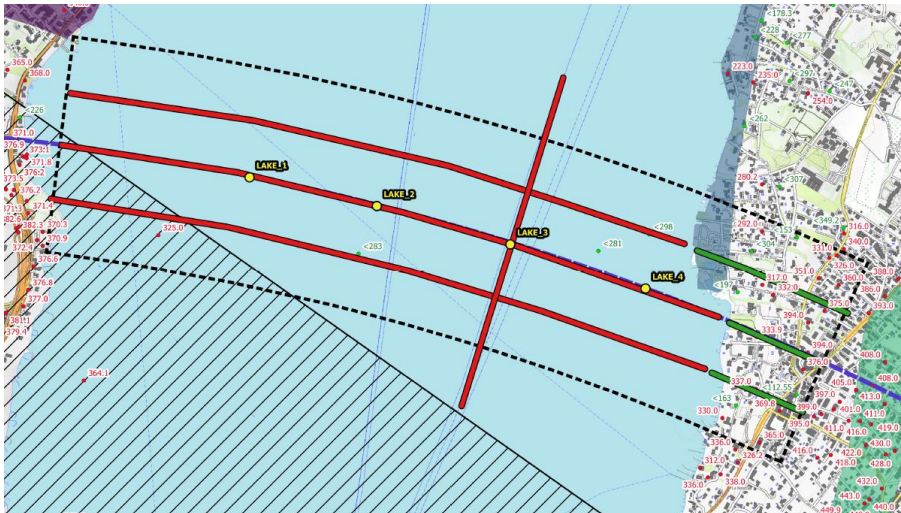
Planned site investigations



# Types of Site Investigations



# SI DEFINITION – LAKE GENEVA

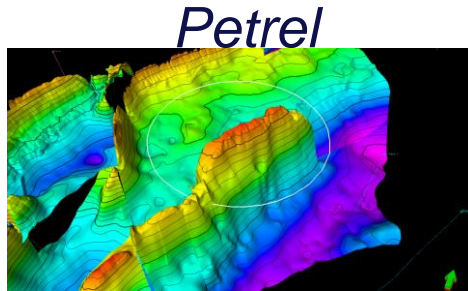


- 3 seismic reflection lines parallel to the alignment
- 1 seismic reflection line perpendicular to the alignment
- 4 fully cored boreholes

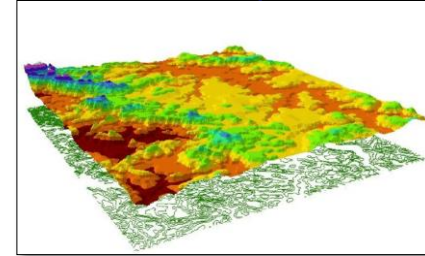


# UNIGE geological model

Collaboration with University of Geneva to develop a 3D geological model  
(October 2020 - Ongoing)



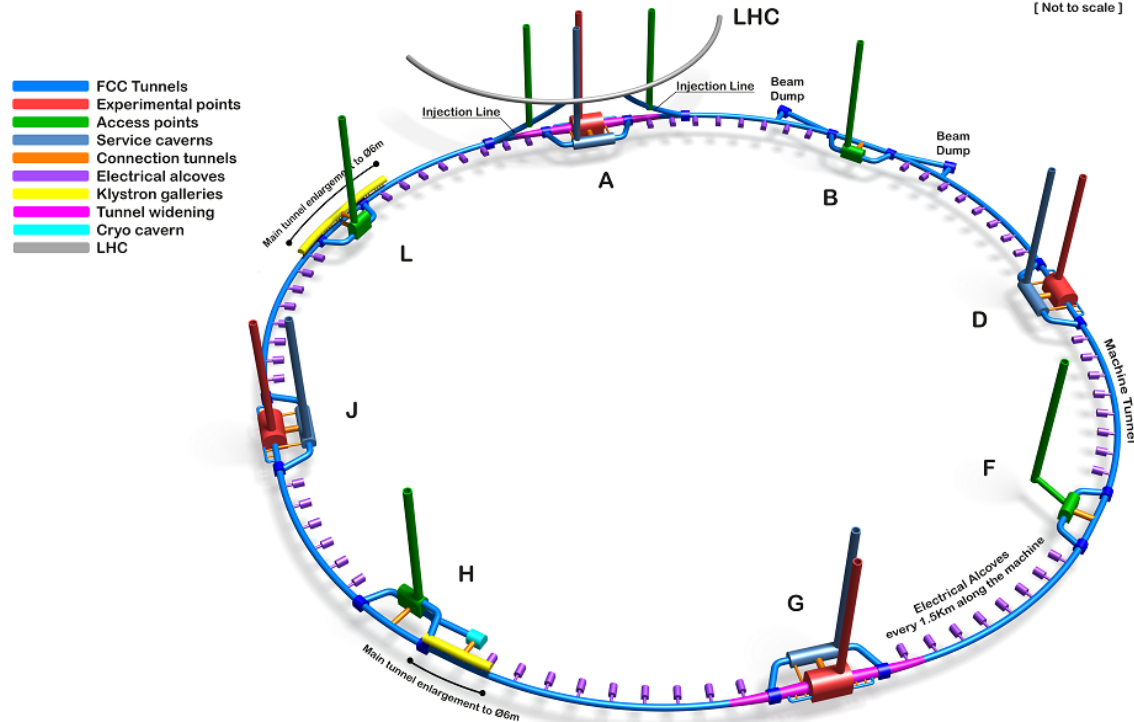
*SOLSTISS (GESDEC)*



- Received an updated molasse and limestone rockhead map
- Updated fault lines layers
- Ongoing analysis of new boreholes and data integration in the model
- New acquisition of BRGM seismic lines and reprocessing

# 8 Point FCC

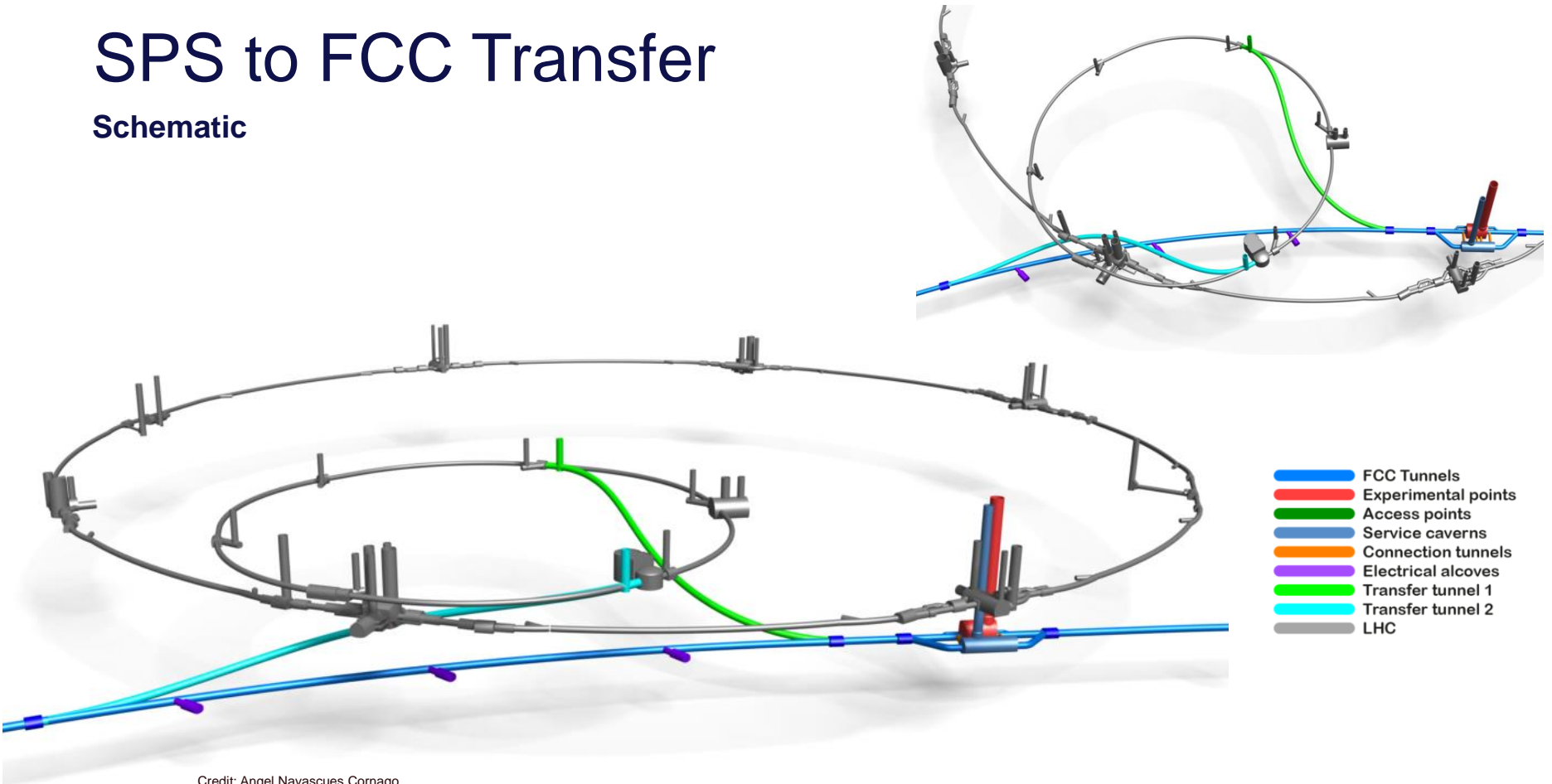
## Schematic



- 8 surface sites
- Sectors of 11 km
- 14 shafts
- Klystron Galleries at Point H and L
- Point H & L tunnel widening to 6.3 m diameter
- 4 Experimental sites
- 4 Technical sites
- Tunnel widening at experiment sites

# SPS to FCC Transfer

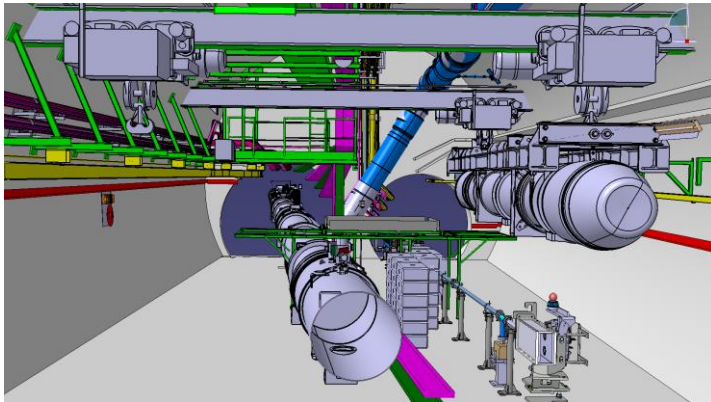
## Schematic





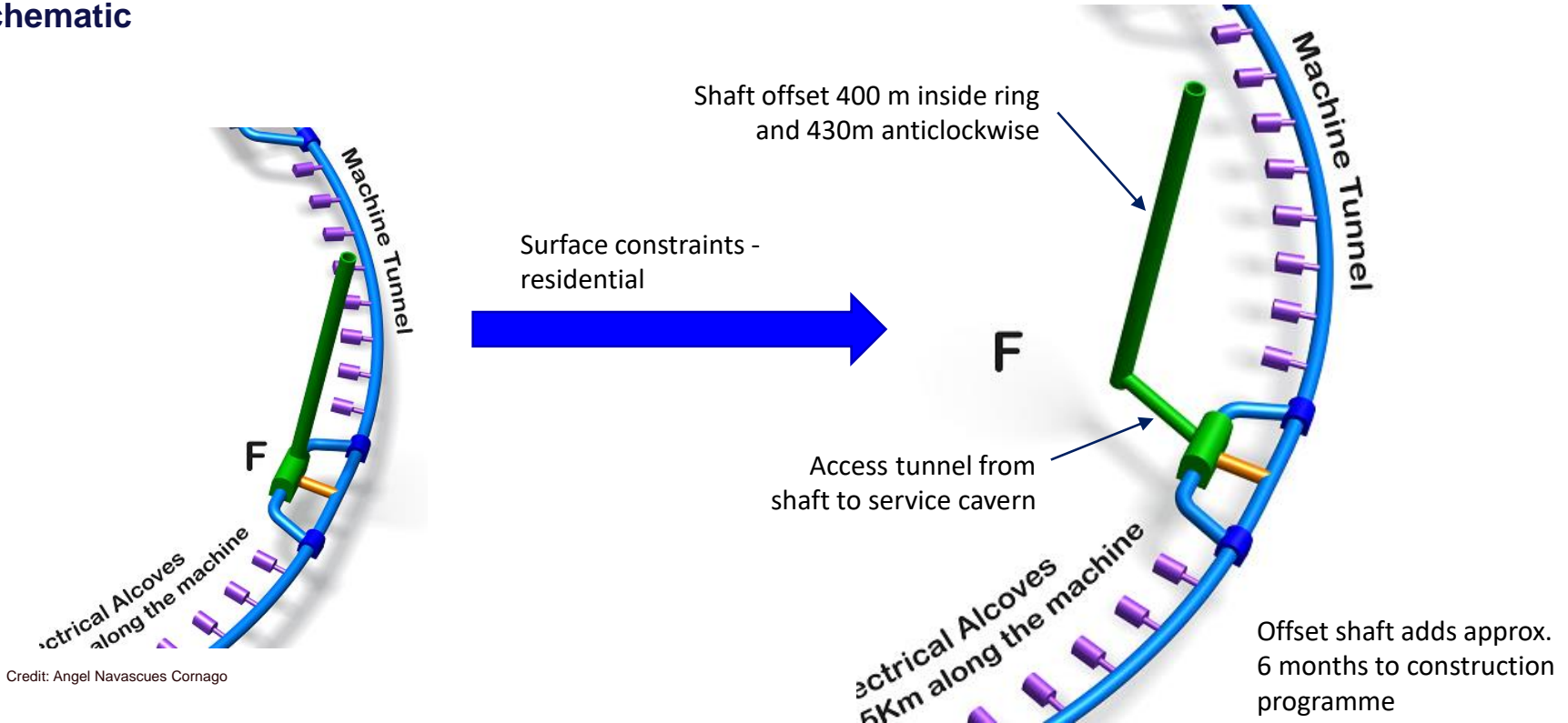
# Existing Transfer Tunnels

## Beam junction

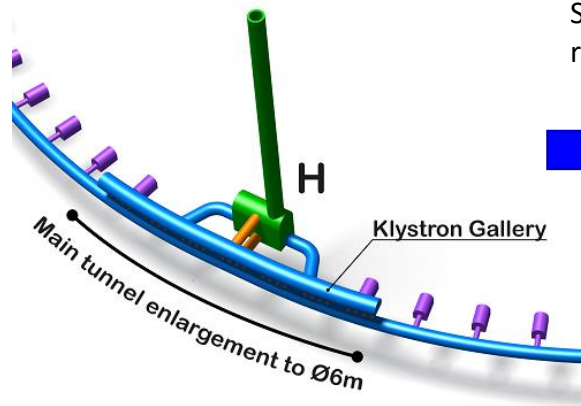


# Offset Shaft - Point F

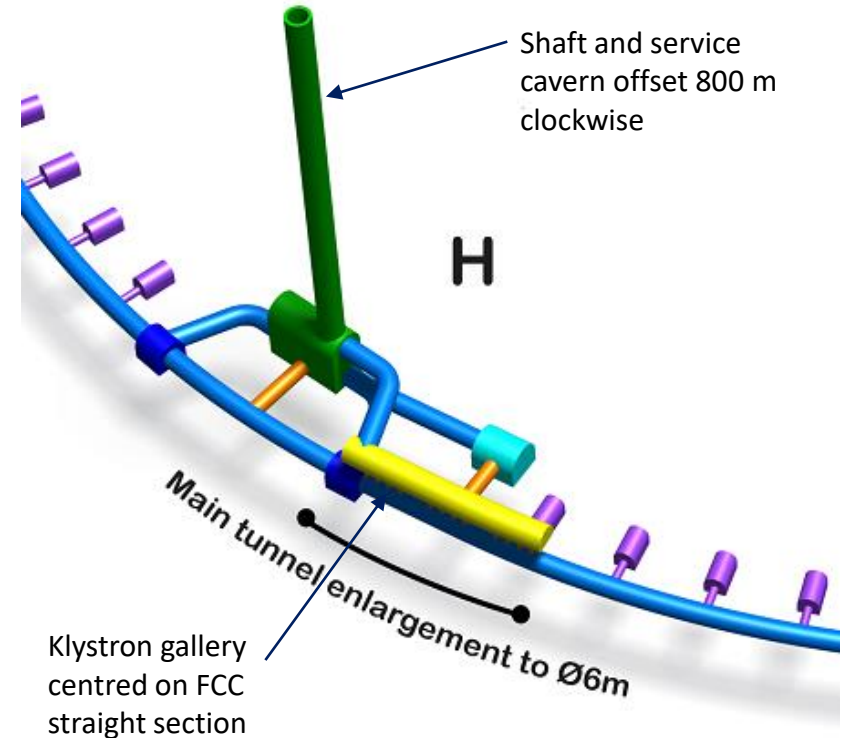
## Schematic



# Offset Shaft - Point H



Surface constraints -  
residential and site access

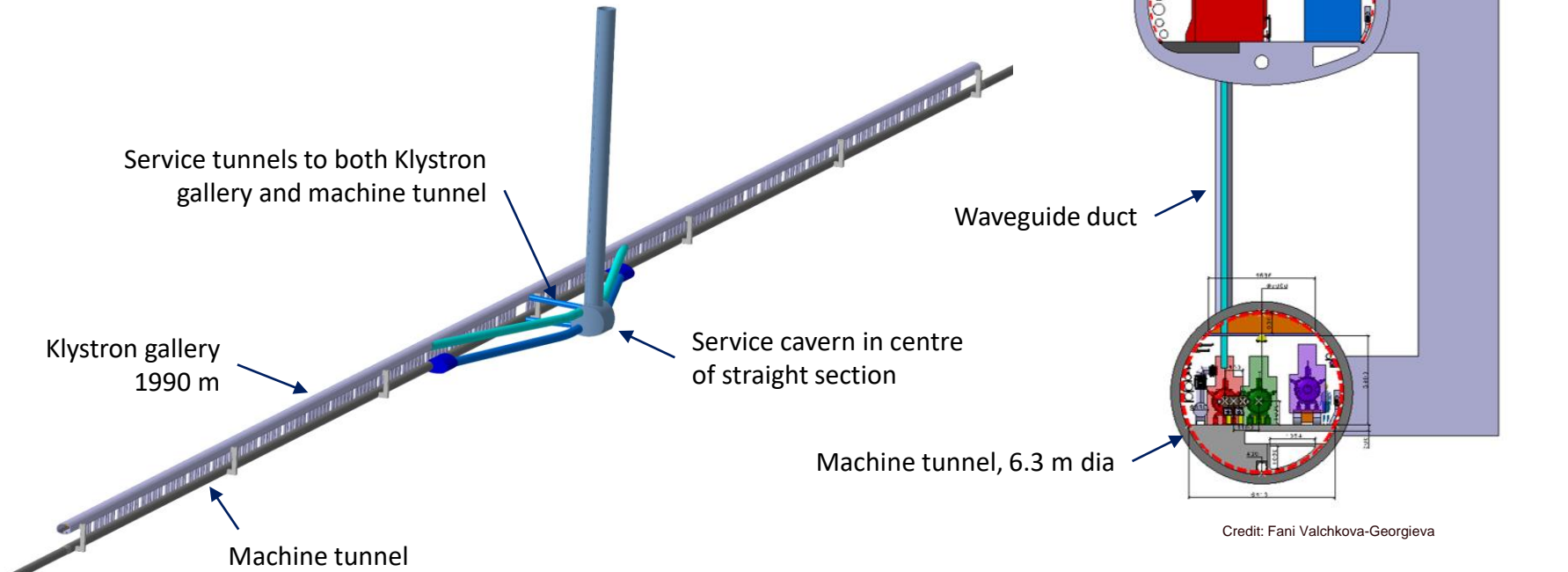


Credit: Angel Navascues Cornago



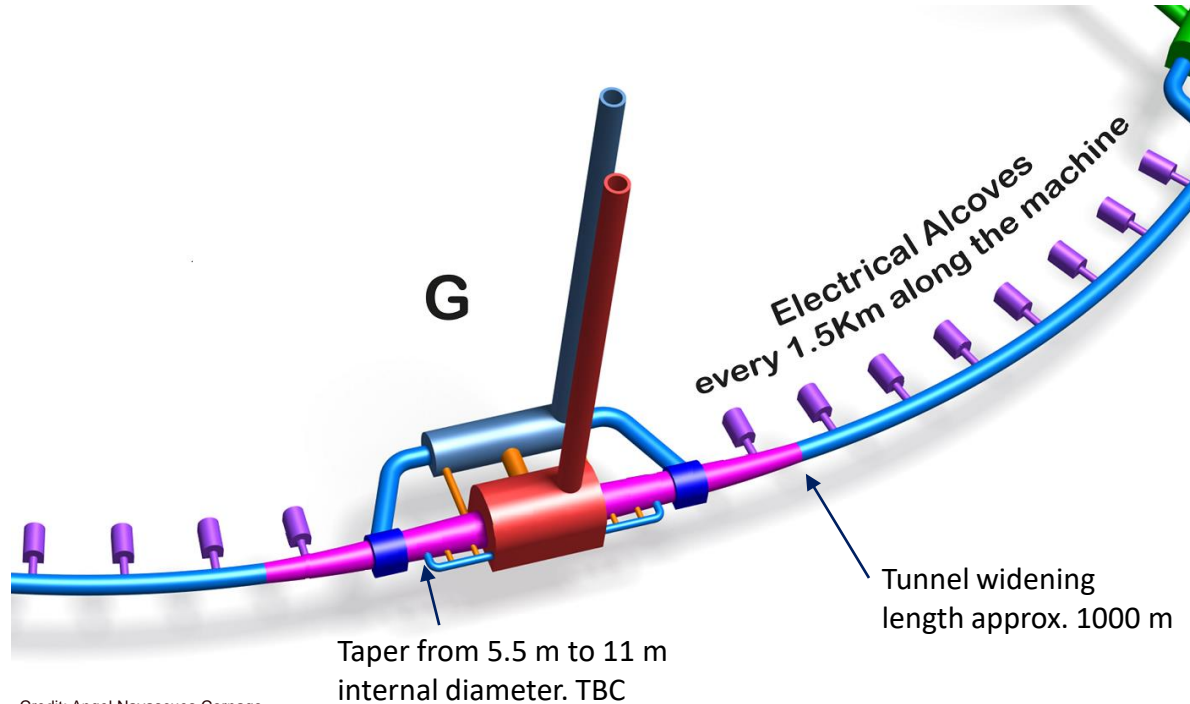
# Klystron Gallery - Point L

1990 m length Klystron gallery

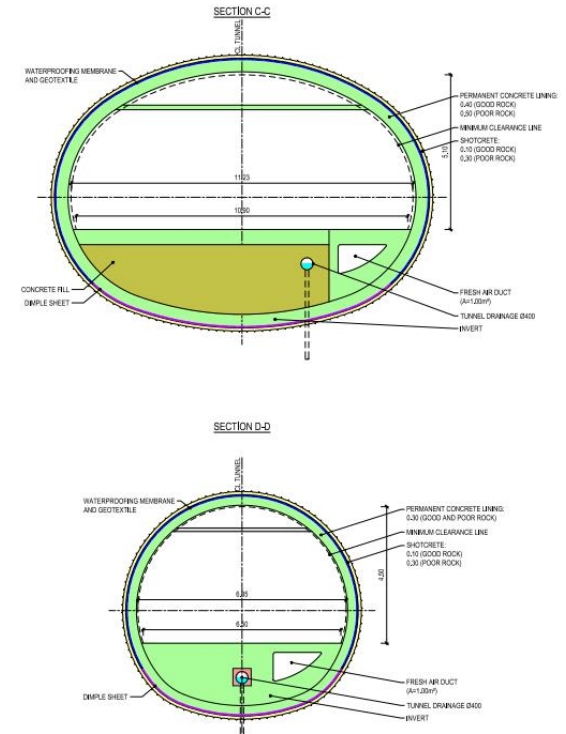


Credit: Fani Valchkova-Georgieva

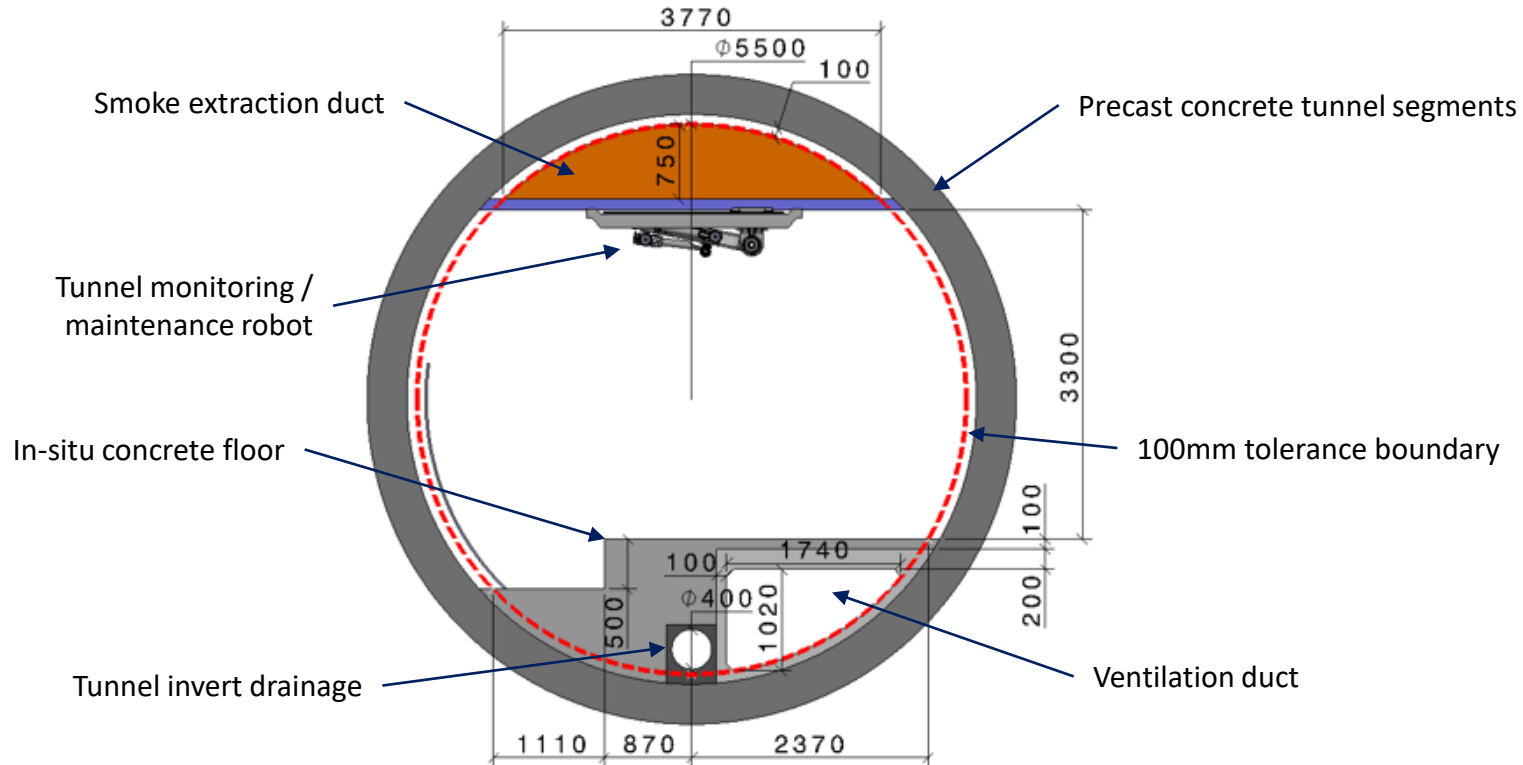
# Tunnel Widening – Experiment Points



Credit: Angel Navascues Cornago



# Main Tunnel Cross Section



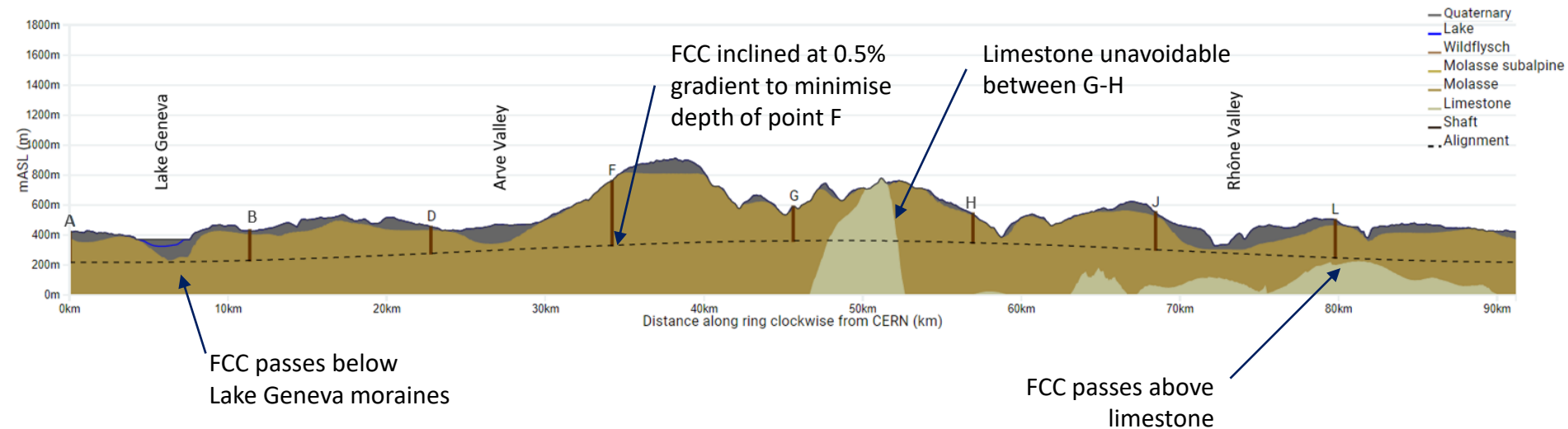


600 m of tunnel equivalent to 35no. 100 m geothermal boreholes

Half the cost



# FCC Long Section – PA31-1.0

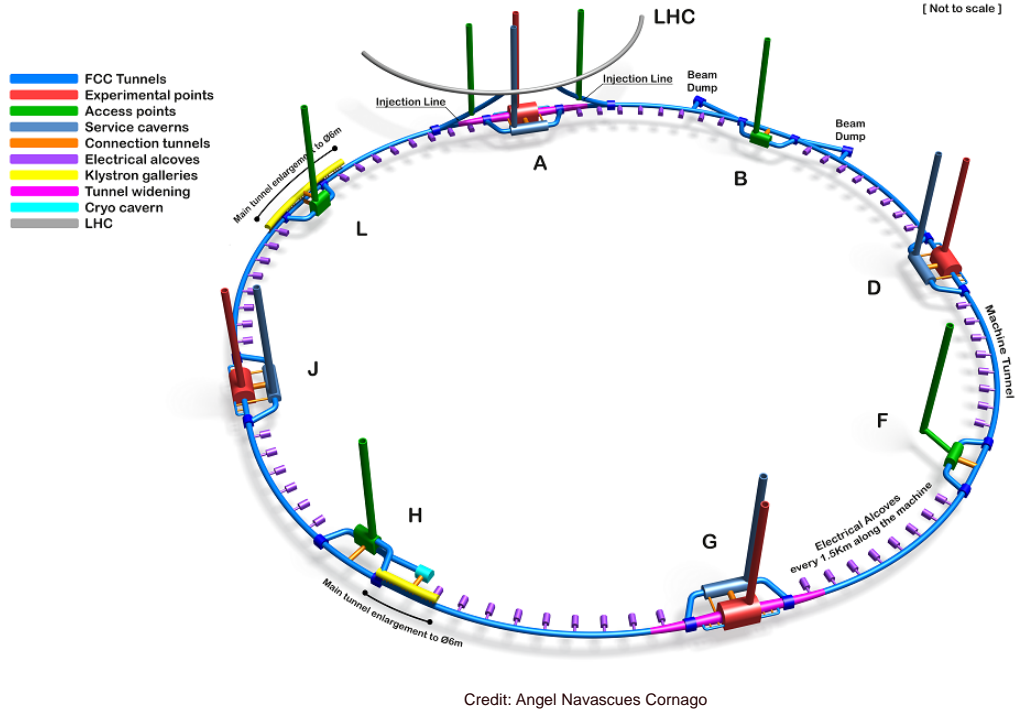


## Shaft depths:

A: 202 m      B: 200 m      D: 177 m      F: 399 m      G: 228 m      H: 139 m      J: 251 m      L: 253 m

**Total shaft depth = 1849 m**

# Future



- Baseline FCC underground structures to be frozen by end of 2022.
- Updated cost / schedule to be provided ahead of mid term review (2023).
- Site investigations commence 2024.



Thank you  
for your attention.