PLACEMENT: REPORT FROM THE REVIEW AND NEXT STEPS

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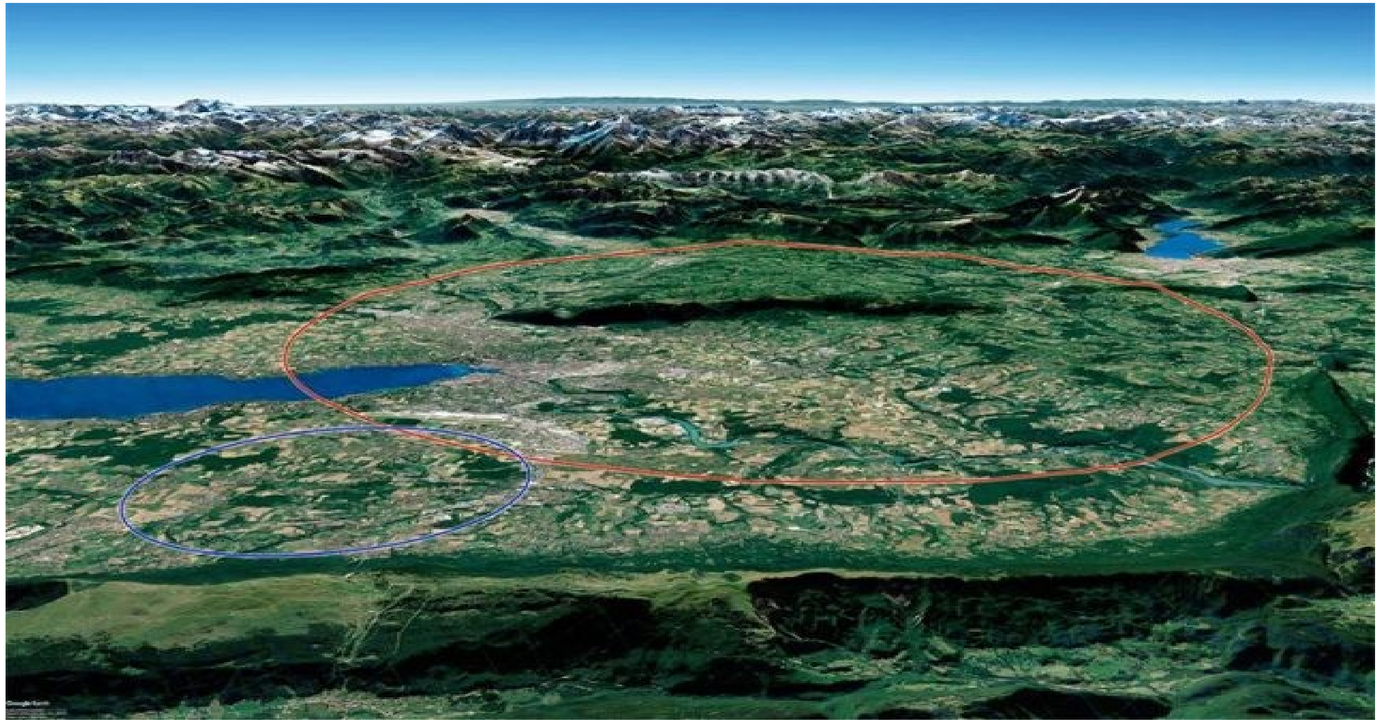
29 June 2021

Content

- **The FCC feasibility study**
- **The Placement Reviews**
- **Needs, contraints and stakes**
- **Conclusion and next steps**



Source: CERN

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The FCC project : 3 main components

- A **research infrastructure** project (surface sites, ring, sub-surfaces structures, injectors, particle collider…)

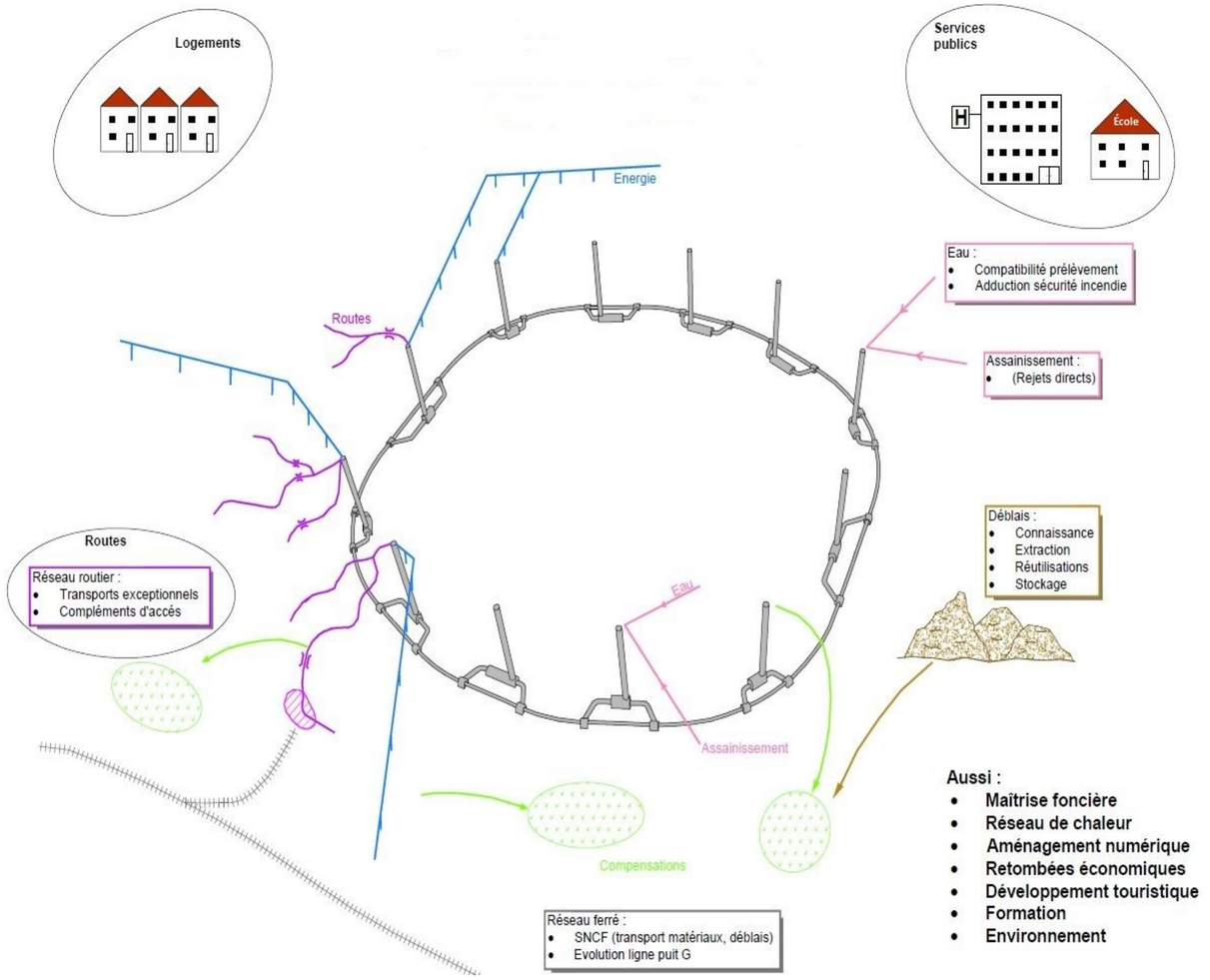
  → **CERN**

- **Development projects** in France to support the research infrastructure

  → **France**

- **Development projects** in Switzerland to support the research infrastructure

  → **Switzerland**



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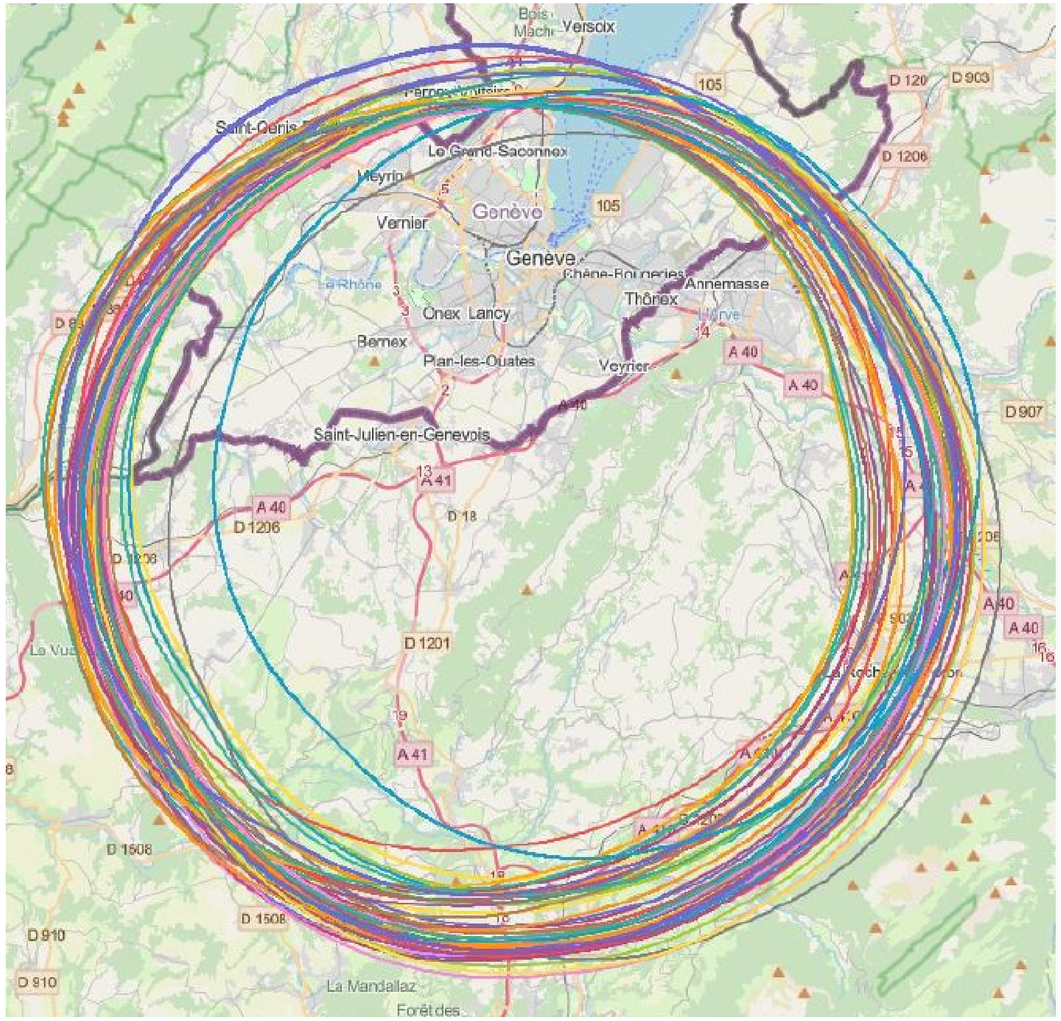
The FCC feasibility Study 2021 - 2025

- Optimise the **layout**, for the ring and the surface sites
- Prepare the **administrative processes** for a potential project approval with the Host States
- Optimise of the **colliders and theirs injector chains**
- Develop and document of the **technical infrastructure**
- Elaborate a **sustainable operational model** for the collider and experiments (human and financial needs, environmental aspects, energy efficiency)
- Consolidate **costs estimates** and **fundings**



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Placement: timeline and steps

- By end of 2021 : identification of preferred layout (ring and surface sites)
- By end of 2022 : identification of geological high risks areas and preparation of site investigations contracts
- 2023-2025 : high risks areas site investigations
- By end of 2025 : placement and feasability analysis concluded

	2021	2022	2023	2024	2025
Technical design work and R&D in all WPs					
Communication plan and implementation			X		
Placements studies, preferred implementation variant identification	X				
General design update for preferred implementation variant		X			
General coherence review across WPs			X		
Detailed design for Feasibility Study Report				X	
Environmental evaluation process and impact study with Host States					
High risks areas site investigations					X
Feasibility Study Report Completed					X

Source: CERN

- Accelerators, technical infrastructure and civil engineering have the same 2025 deadline, with a mi-2023 coherence review

Placement Review : 7 and 8 june 2021

- Meeting with :
  - Members of the FCC International Advisory Committee,
  - Representatives of the Host States,
  - Technical experts,
- Goal : to review progress, to confirm the methods applied, to guide the choices for the project
- The purpose of this presentation is to outline the main elements of this review

Source: CERN

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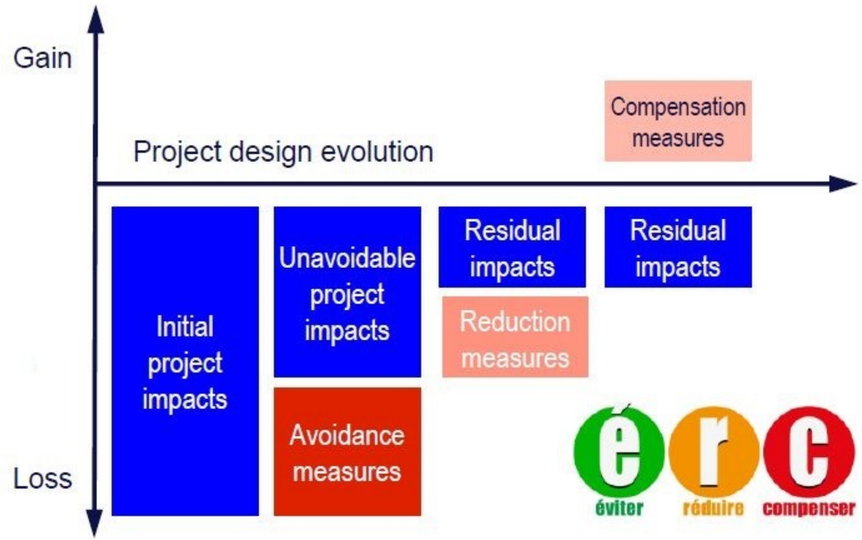
Placement : make the right upstream choices

- Applying the Avoid – Reduce – Compensate approach
- Method of sustainable developement and also principle of the French Law
- The consideration of impacts must therefore also include a set of objects necessary for the research project, such as: roads and accesses, electric networks, water needs, accommodation for staff, public services (schools, hospitals…)
- Excavated materials (very large volumes) must also be taken into account



Source: CERN

- This principle is based on 3 steps:
  - Avoidance of impacts upstream of the project
  - Reduction of impacts that couldn't be avoided
  - Compensation for residual impacts. This means that if the project destroys a certain area of natural environment, you have to reconstitute it elsewhere

High level needs and constraints

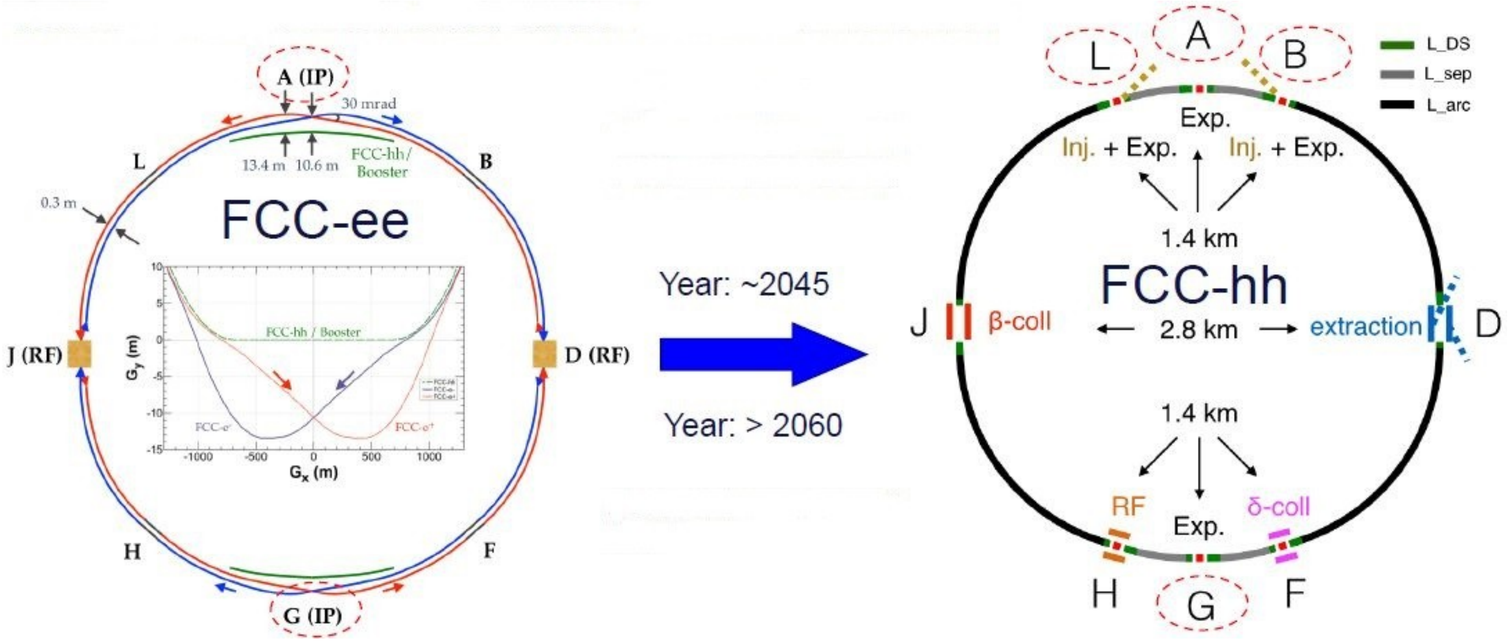
Scientific excellence:

- Circumference **≥ 90 km**
- **Possibility** for **4 experiment sites** for both machines (ee, hh)
- **No displacements** at **experiment** sites
- **Displacements** along ring
- **Access tunnels** preferrably < 250 m, not longer than 600 m
- **Sites** close to transport infrastructures & **accessible** (road, railway...)

Ring and surface sites need to serve 2 particle colliders :

- FCC-ee : lepton collider

- FCC-hh : hadron collider



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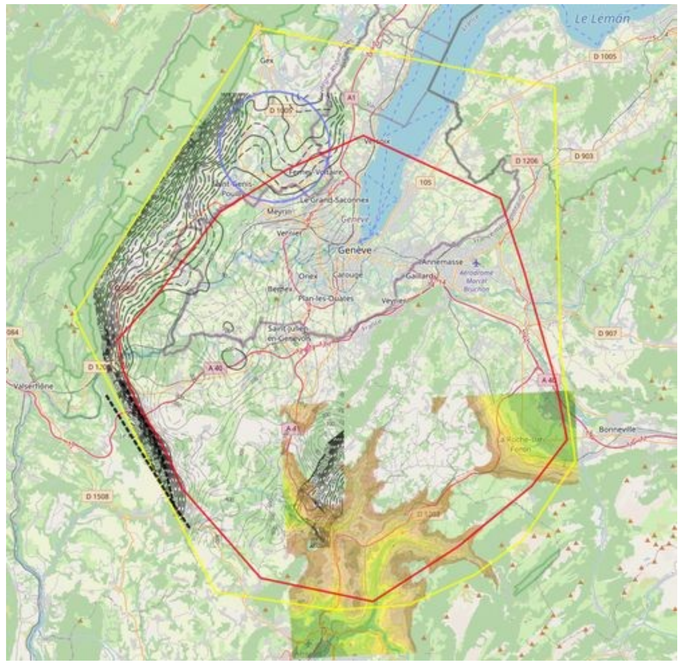
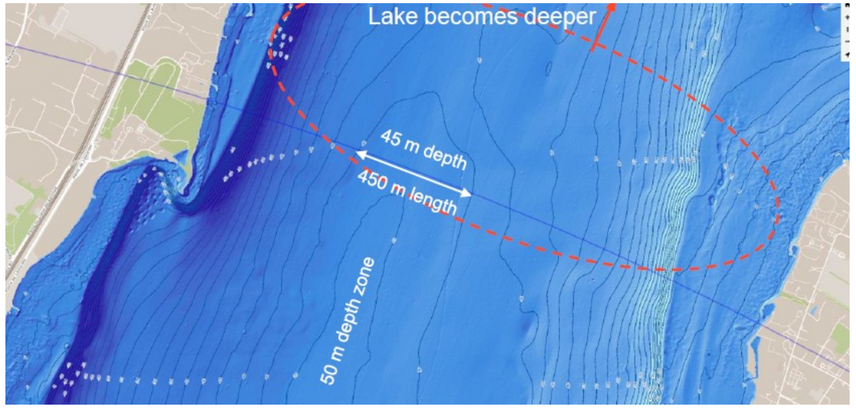
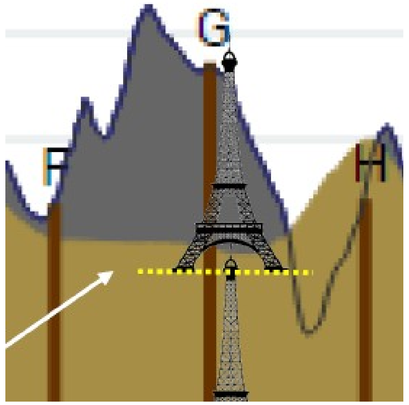
High level needs and constraints

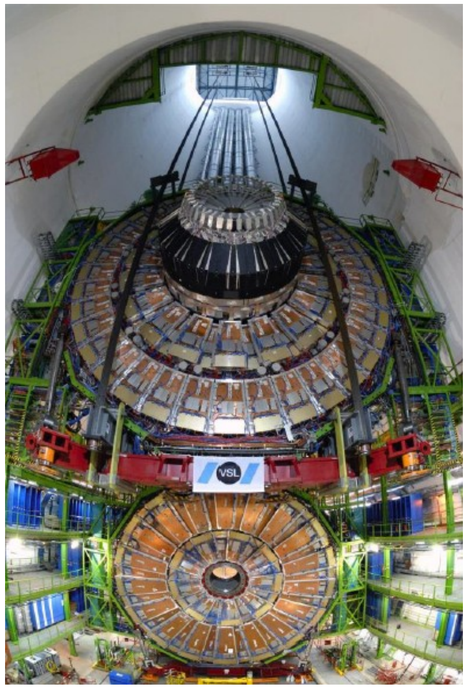
Project risk:

- **Avoid Vuache top of limestone** (200 m above sea level)
- **Avoid Jura top of limestone** (250 m above sea level)
- **Avoid high altitudes** (higher than 700 m above sea level)
- **Shaft depths < 300 m** at **experiment** sites
- **Shaft depths < 400 m** at **technical** sites
- Stay **50 m below lake bed**
- Not too close to Rhône
- Attention at Arve crossing
- Mind overburdens
- Avoid sites at water bearing areas









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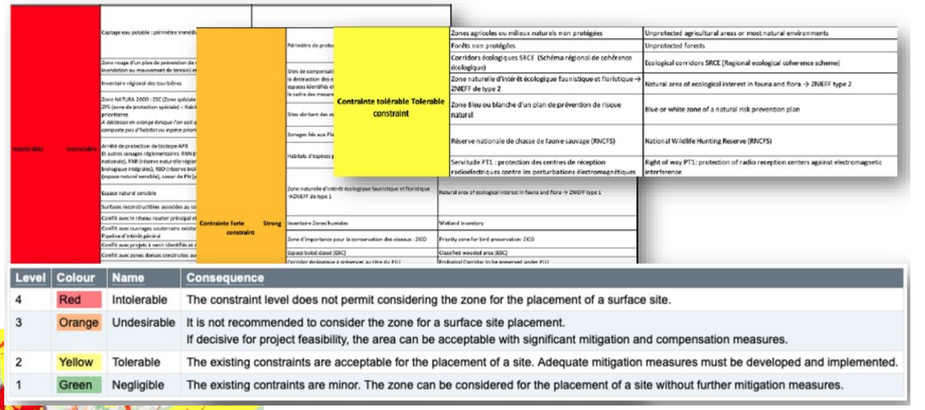
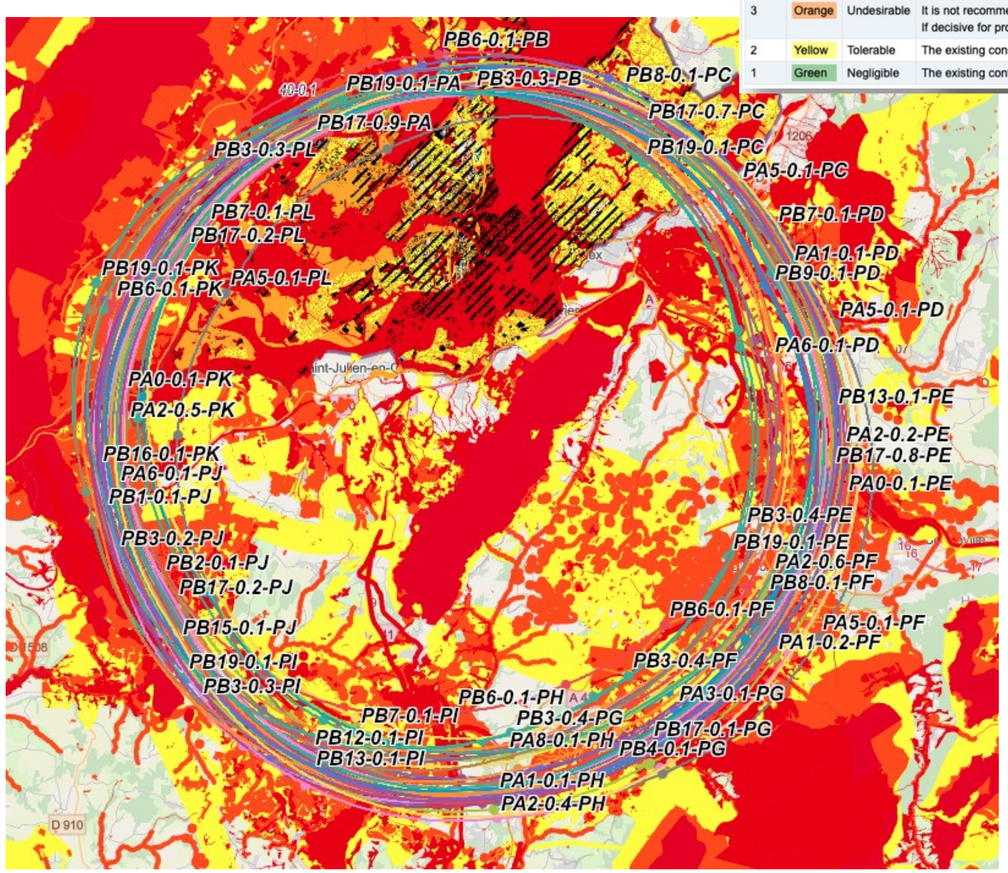
High level needs and constraints

Territorial aspects:

- **Avoid “red” areas** (regulatory constraints...)
- **Avoid water protection** zones
- Avoid wetlands where possible
- **Avoid** locations where **opposition** is likely
- Prefer agricultural plots
- **6 ha for experiment** sites, 5 ha for other sites, **3 ha minimum**. Accept split sites.
- Assure possibility for accessibility
- **Mind** vicinity to **residential areas** & **nuisances** (construction)
- **Avoid forests** that are **difficult to access** and **topographically not advantageous**



Level	Colour	Name	Consequence
4	Red	Intolerable	The constraint level does not permit considering the zone for the placement of a surface site.
3	Orange	Undesirable	It is not recommended to consider the zone for a surface site placement. If decisive for project feasibility, the area can be acceptable with significant mitigation and compensation measures.
2	Yellow	Tolerable	The existing constraints are acceptable for the placement of a site. Adequate mitigation measures must be developed and implemented.
1	Green	Negligible	The existing contraints are minor. The zone can be considered for the placement of a site without further mitigation measures.



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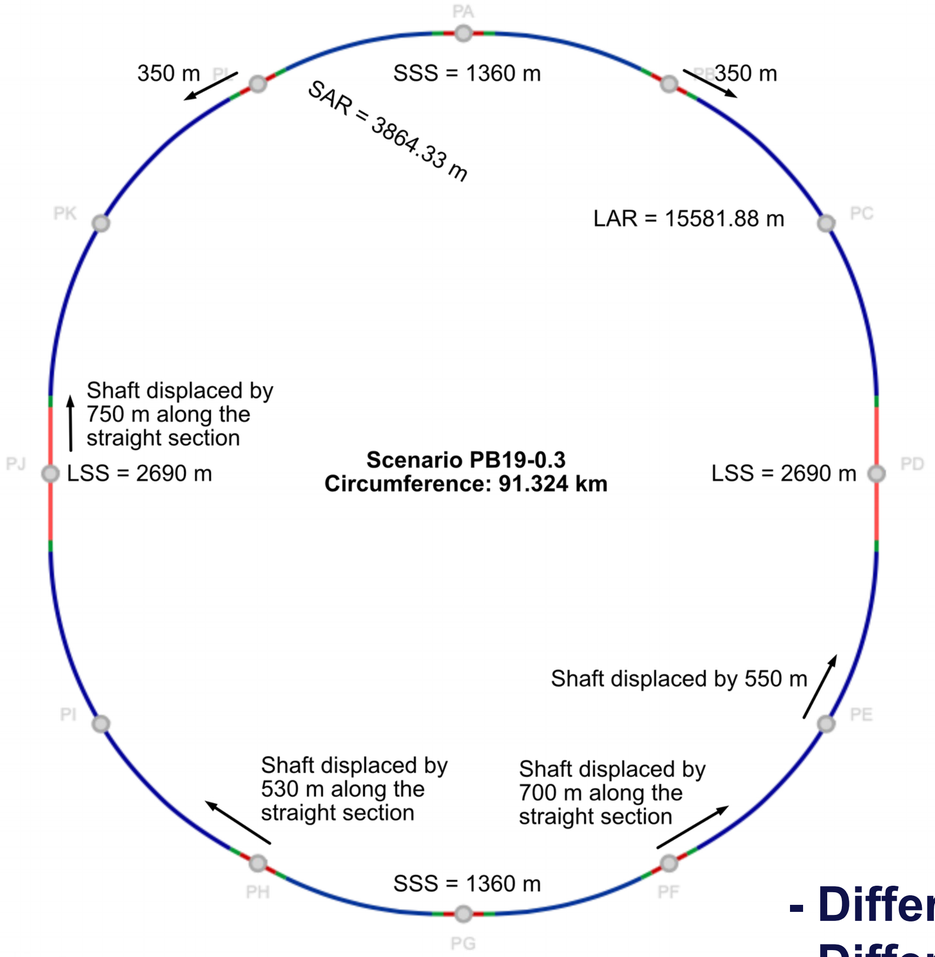
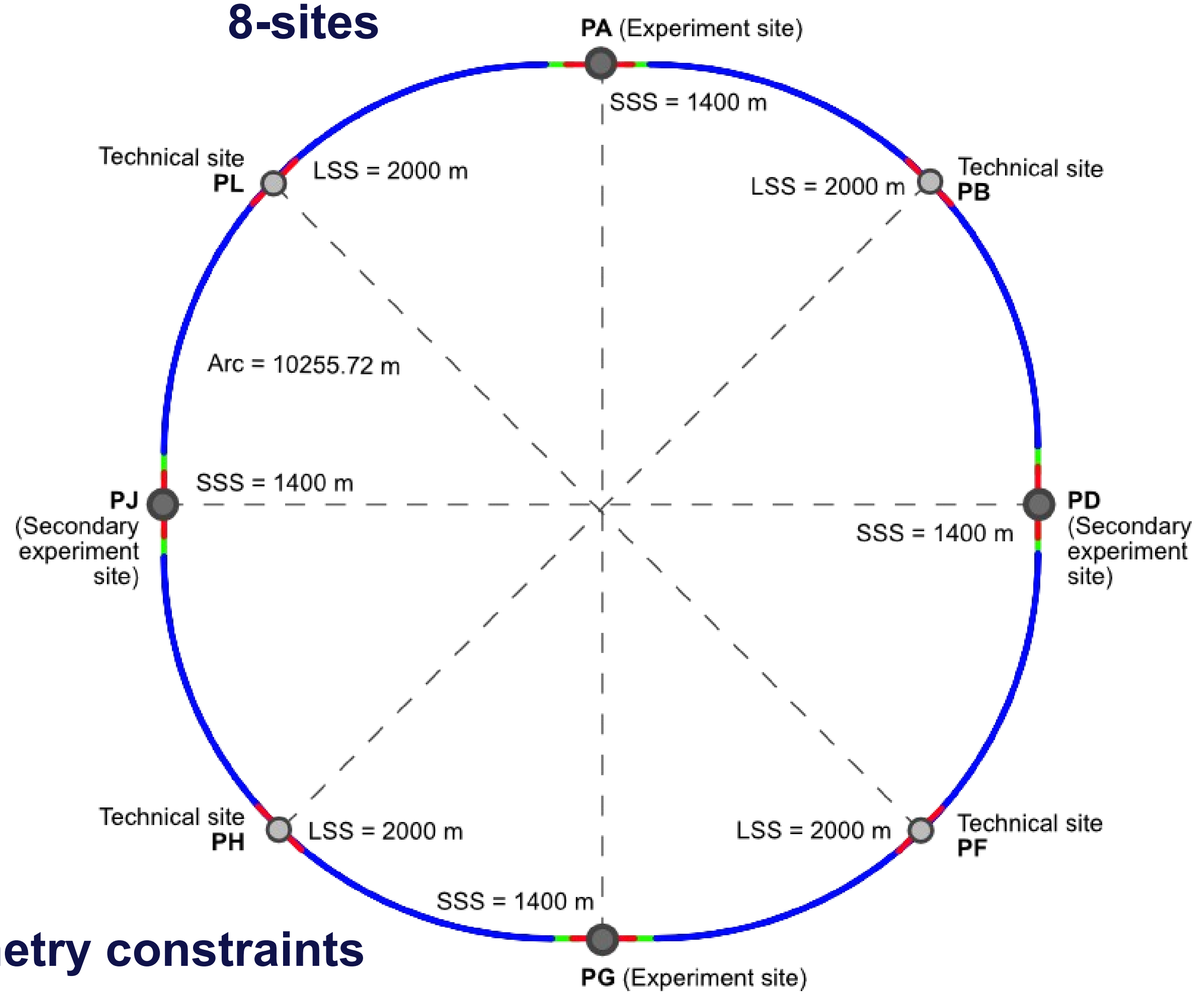
2 famillies of layout : 12 or 8-sites

12-sites



8-sites



- **Different symmetry constraints**
- **Different shapes**
- **Different degrees of freedom**

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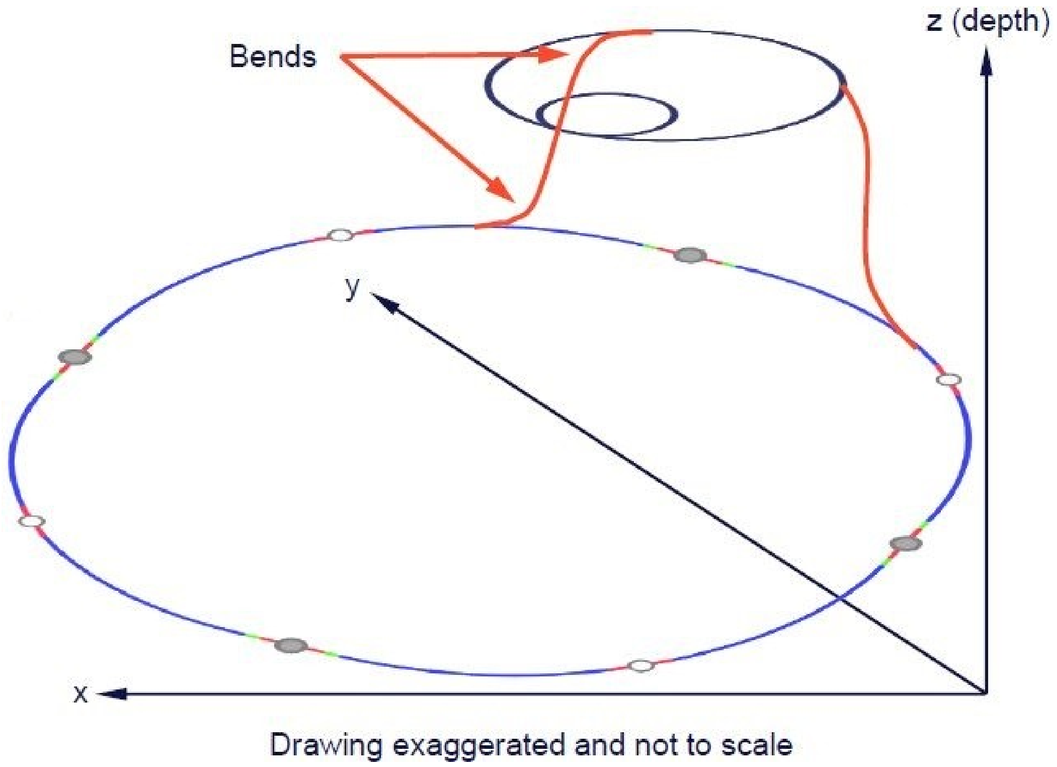
Layout flexibility

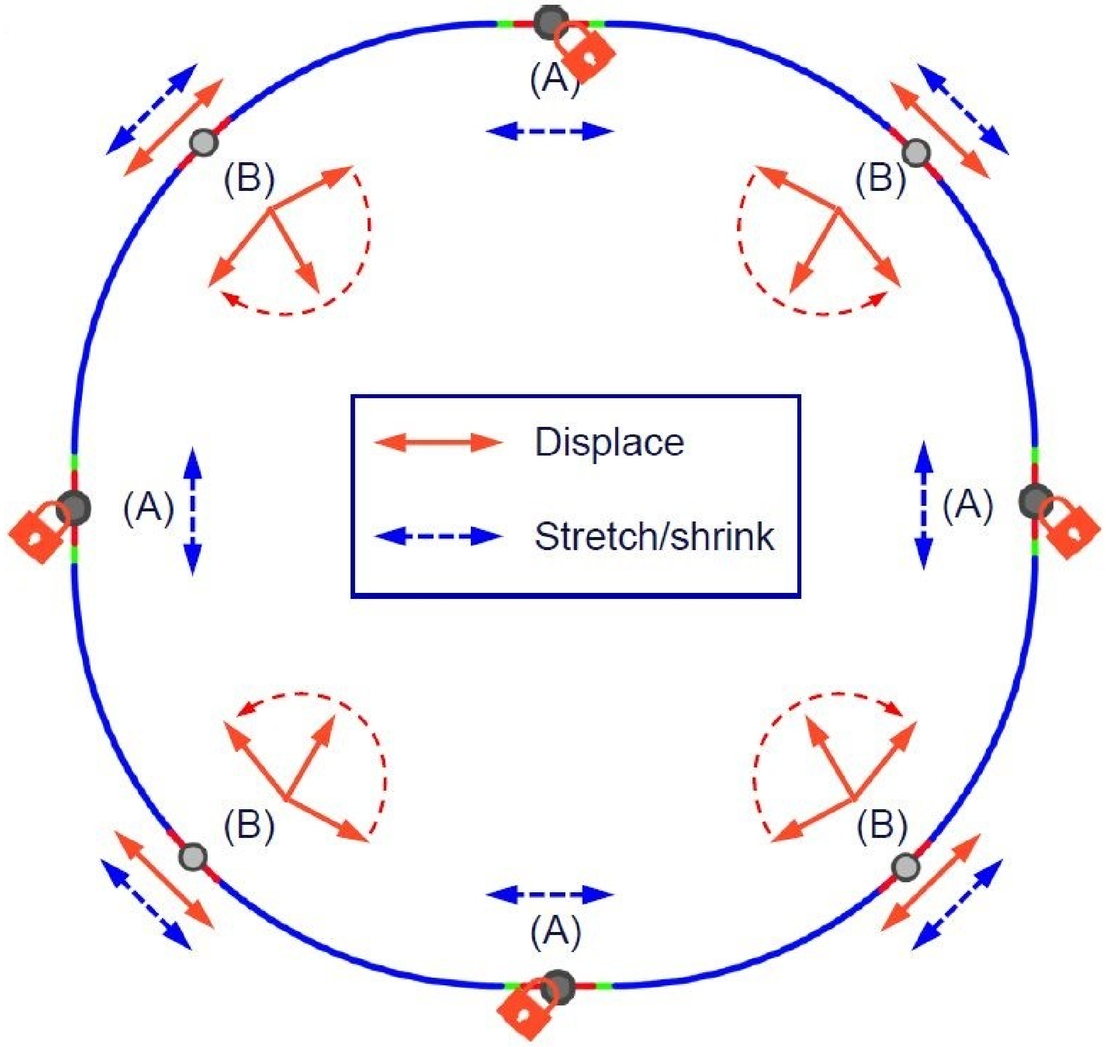
Connection to LHC/SPS:

- LHC, SPS or both



Possible displacements

- The less, the better



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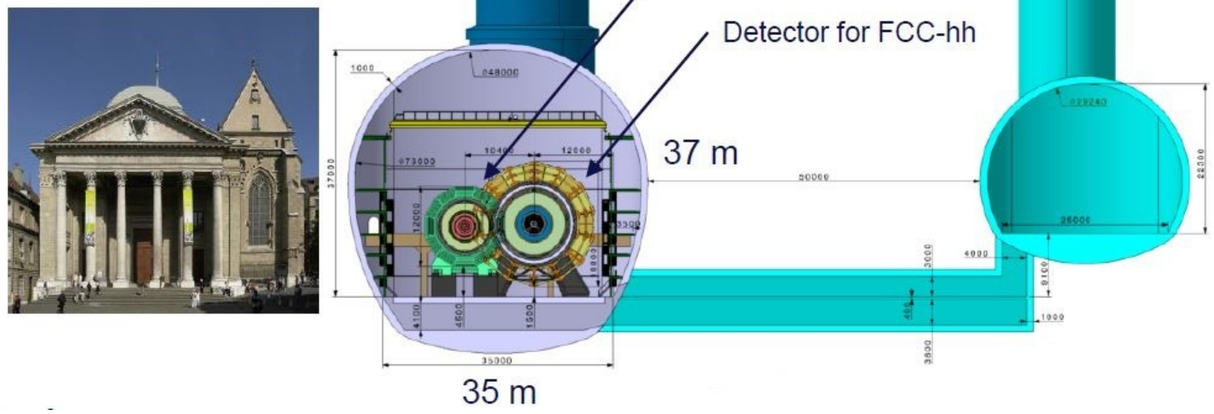
Site constraints

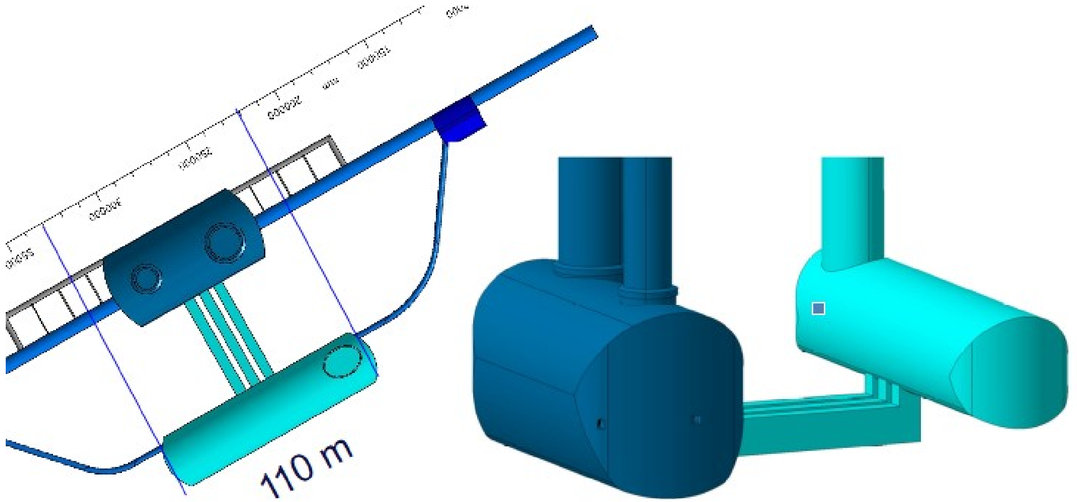
Experiments sites:

- 2 – 3 shafts
- 1 shaft right on top



Technical sites

- 1 service cavern
- 1 shaft inside the ring

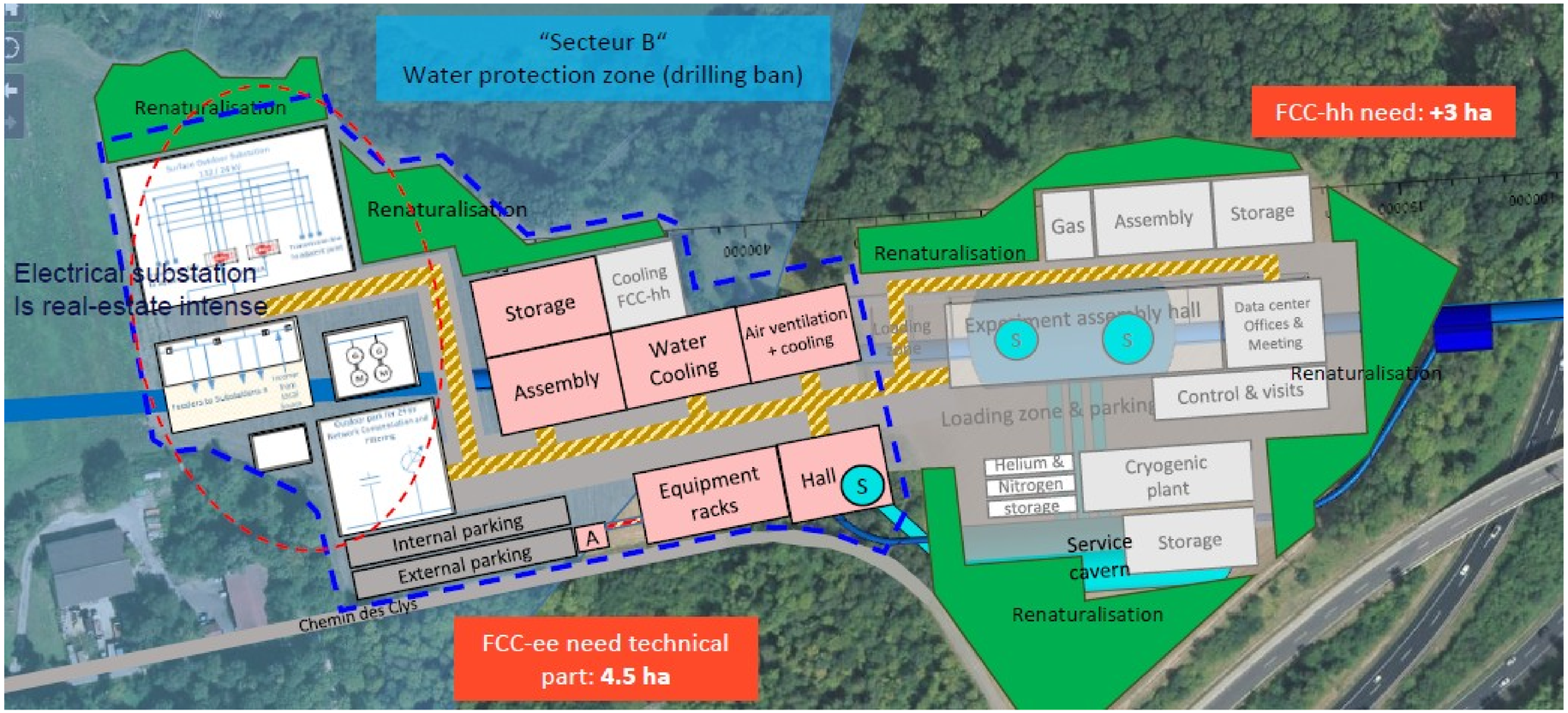


Elements of a surface site

Many functions:

- Shaft access
- Cryogenics
- Machine powering
- Water cooling
- Ventilation
- Electrical substation
- Workshops
- Storage
- Parkings
- Assembly halls
- Data center

Layout exercise reveals that about 7 ha are needed for an experiment site
(Indicated location is not part of a preferred placement scenario)



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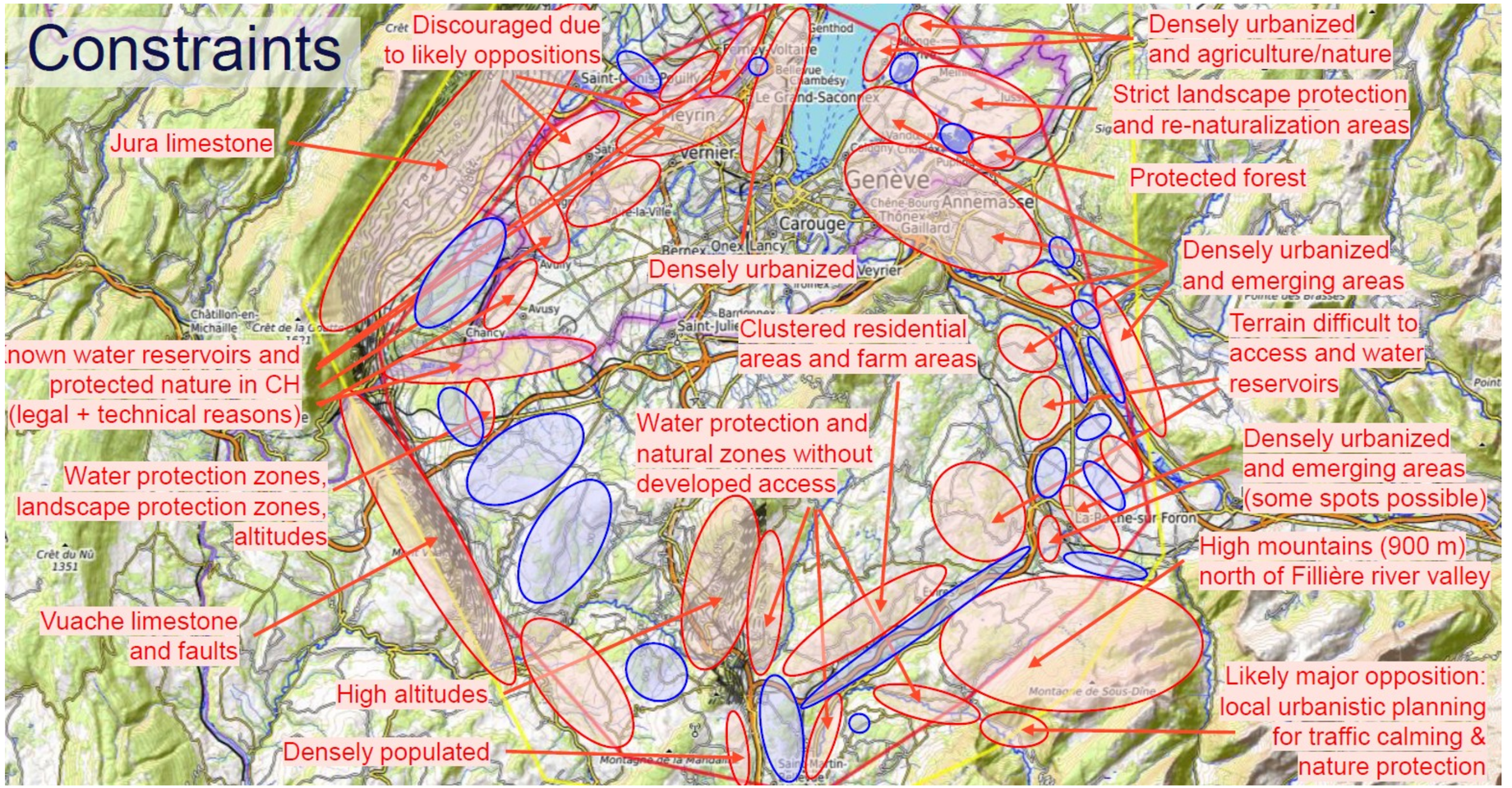
Constraints

Many constraints determine scenario development:

- Topography
- Geology
- Water datas
- Territorial constraints (environment, risks, land use…
- Networks (transports infrastructures, energy, pipelines, communication...)



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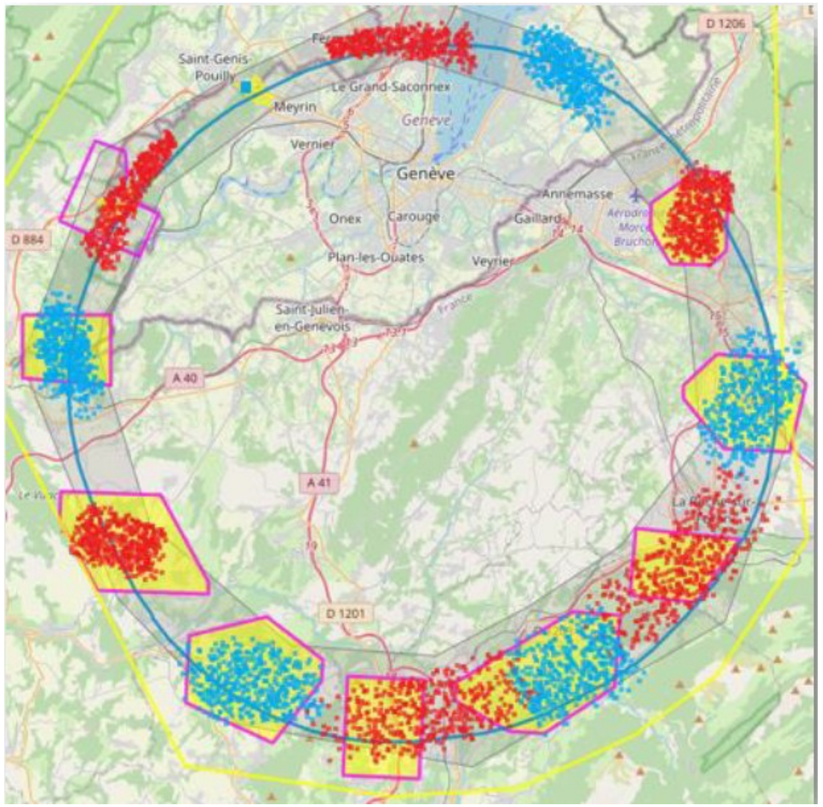
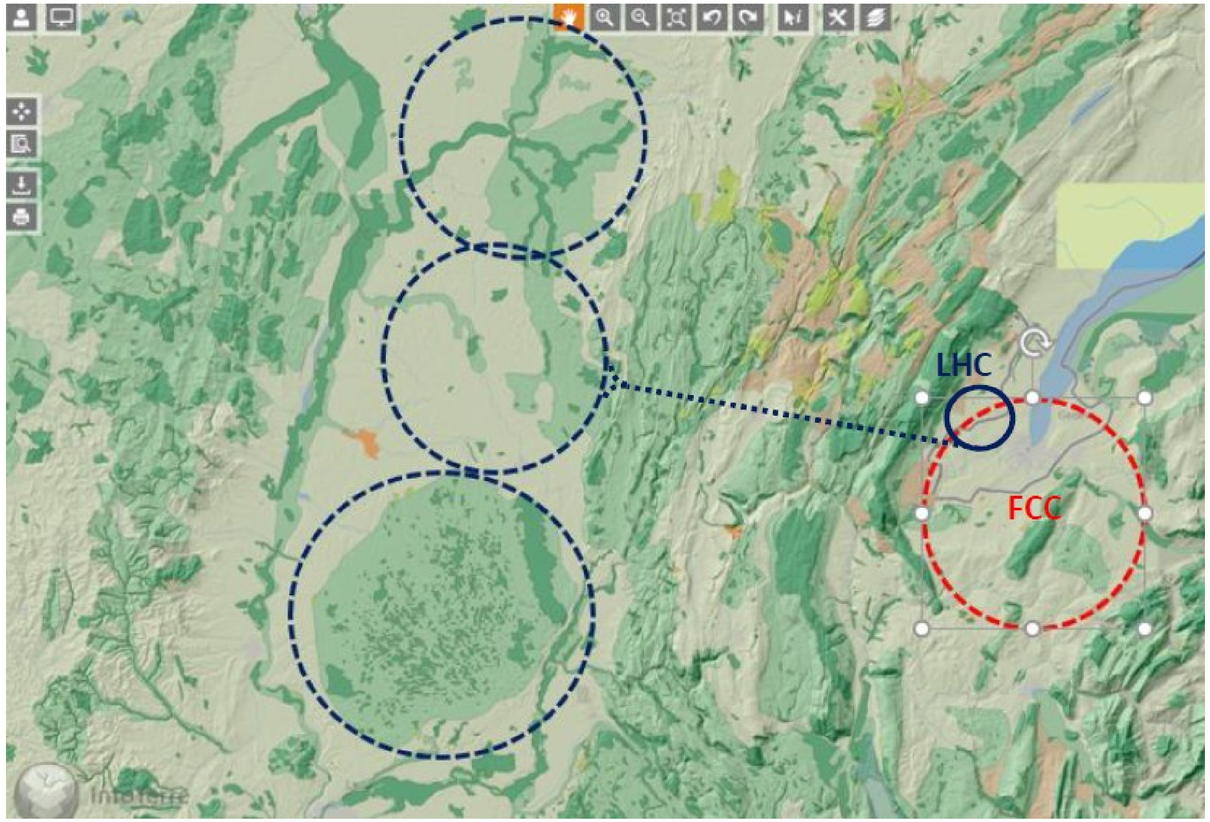
Avoid – Reduce – Compensate method

Many (several hundreds) scenarios analysed:

- Iterative approach
- In the early stages of the study, even a trans-Jura variant was examined





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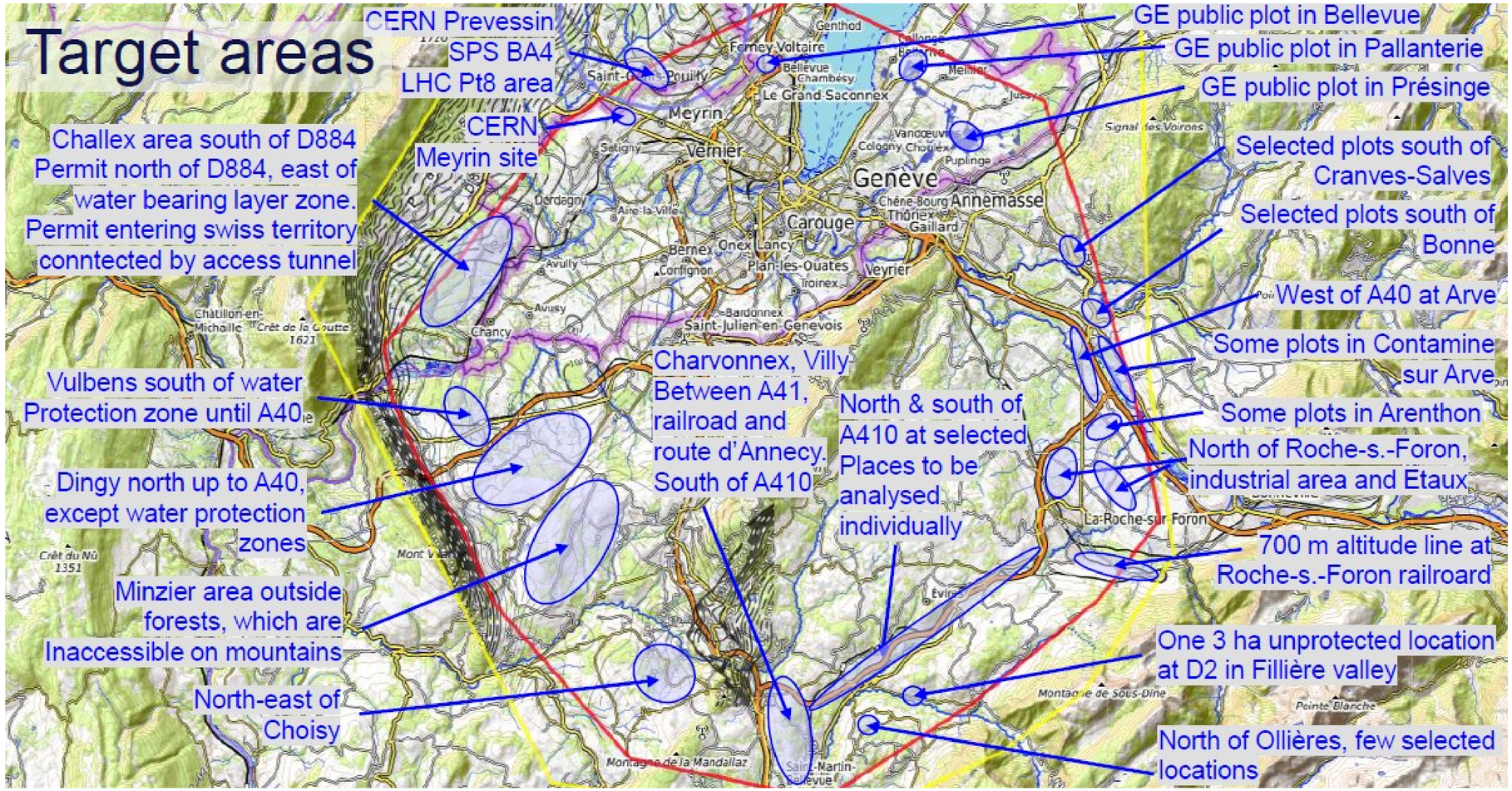
Target areas

Resulting size:

- Most frequent feasible scenarios in the 92 km range or smaller
- Some potentially feasible scenarios exist in the 93-94 range with increased geological risks
- Best geolocial and territorial fits in the 89 to 91 km range.



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Multi-Criteria Optimisation

32 territorial compatibility criteria

5 overall trace criteria

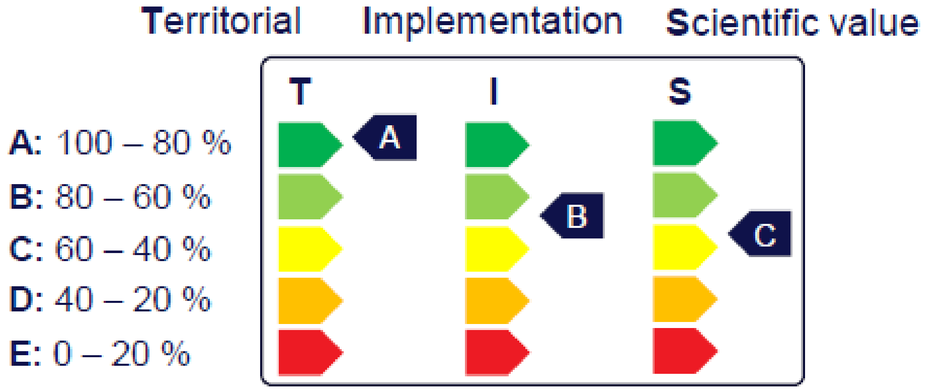
Land status
Plot availability
Clean and clear title to obtain rights on plot
Plot price
Time for acquisition
Cost of plot development
Connectivity
Distances from transport and infrastructures
Distance from populated areas
Raw materials and services
Availability of raw materials
Proximity to service providers
Infrastructure
Accessibility of electrical power
Communication networks
Water for industrial use
Drinking water
Sewerage disposal and treatment
Temporary storage areas during construction

Physical features
Plot size and shape
Topography
Shaft depth
Drainage conditions
Surface ground conditions
Water resources
Accessibility
Physical subsurface conditions
Regulatory subsurface conditions
Environmental and social factors
Territorial constraints
Fauna and flora
Existing construction constraints
Adjacent surrounding constraints
Nuisances
Workforce availability and accessibility
Local government support
Civil society support

Overall layout
Geometry
Size
Transfer line compatibility
Project cost
Overall scenario cost
Project risk
Overall scenario implementation risk

Follows UNIDO best practice for planning "industrial type" installations

To guide the choice of one prefered scenario



	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	Trace	Total Score
PA3x-0.y														+5
Score %	95	71		89		75	77	70		70		75	75	78
PA3a-0.b														+4
Score %	86	71		89		75		70		64		66	75	75
PA3c-0.1d														+1
Score %	85	64		75		58	33	58		63		73	75	65
PA3e-0.f														+2
Score %	75	84		80		57	74	33		50		49	70	64

EXAMPLE

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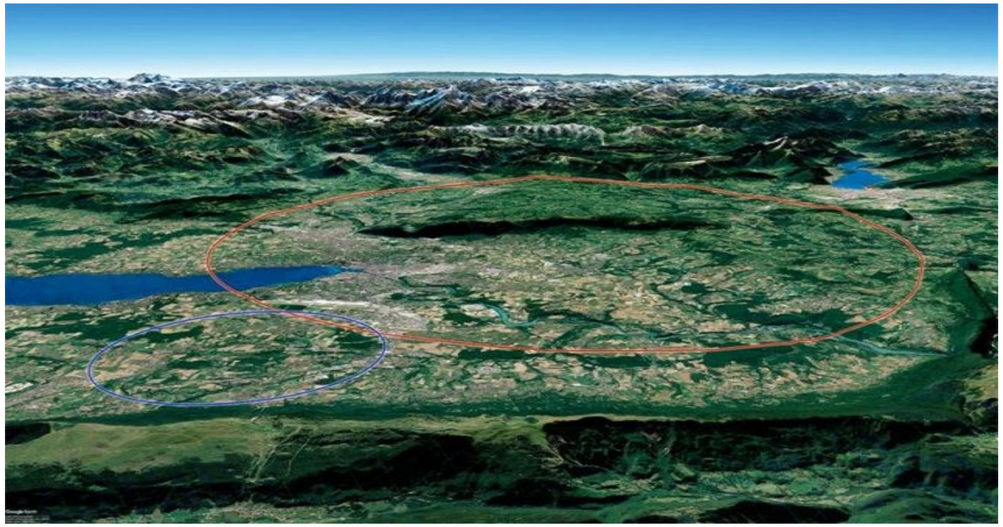
Conclusions of the Review

Many rich discussions during the review.

Main conclusions are the following:



- The **general method** is confirmed
- The importance of **territorial constraints** is affirmed
- The interest in **8-sites** layout is shared
- **Information on maps and in existing documents have been exhaustively analysed**
  Sites investigations are necessary to progress
- Most suitable scenarios are in the 89 km to 91 km range
- **Verification of territorial feasibility depends on a direct feedback from local authorities on the in-principle possibility and willingness to host surface sites**
- The **choice of one layout** and placement as a case-study is therefore necessary now
- Currently a preferred scenario with a total circumference of 91 km is being developed for a feasibility analysis with host state partners.

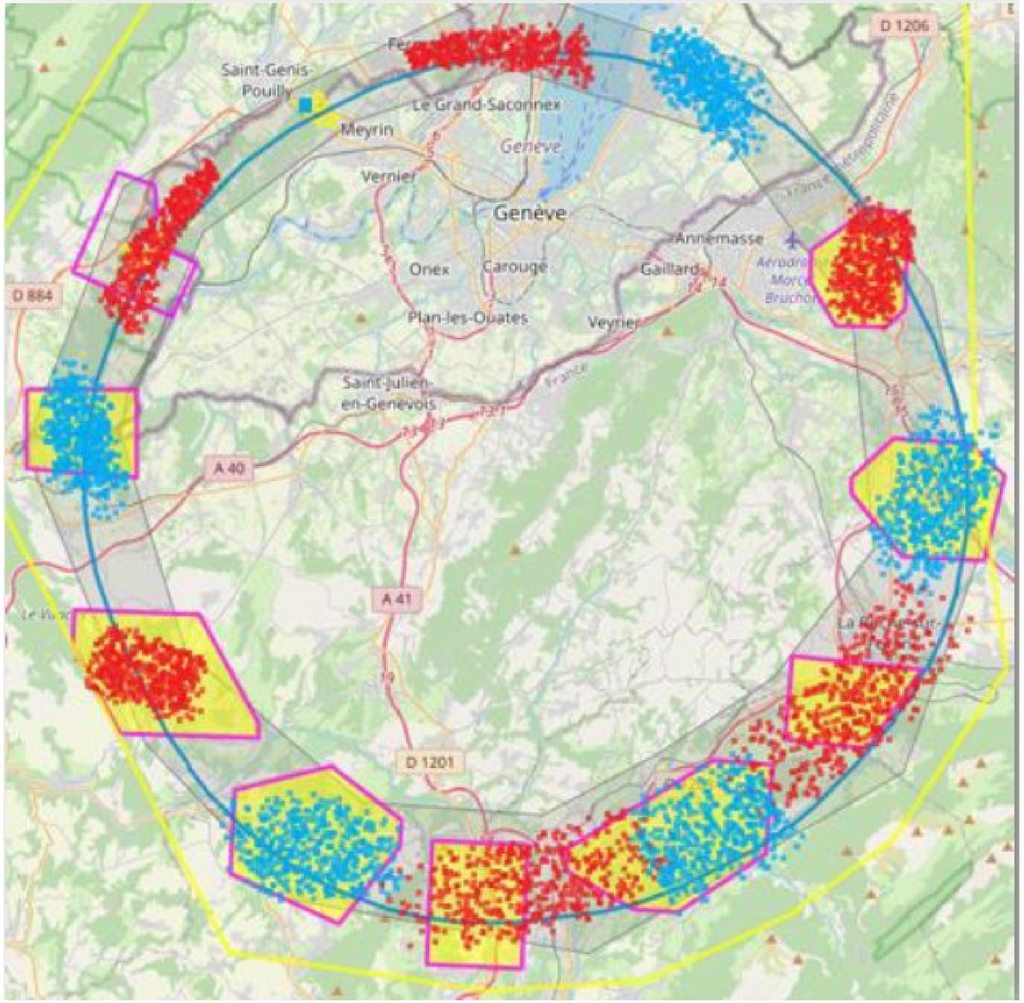
Next steps...

Next steps :

- Work on the developement of the new scenario baseline
- Conduct consultations with stakeholders and partners
- Prepare the high risk area investigations
- Optimise towards a preferred scenario

To bear in mind :

- Territory evolves without stop...
- Constraints continue to increase...



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