IMPLEMENTATION SCENARIO DEVELOPMENT

J. GUTLEBER, CERN

FCC WEEK 2024, SAN FRANCISCO

10 JUNE, 2024

FCCIS – The Future Circular Collider Innovation Study. This INFRADEV Research and Innovation Action project receives funding from the European Union's H2020 Framework Programme under grant agreement no. 951754. The information herein only reflects the views of its authors and the European Commission is not responsible for any use that may be made of the information.

Territorial scenario development (recap)

Alternatives and variants analysed, unfeasible ones discarded.

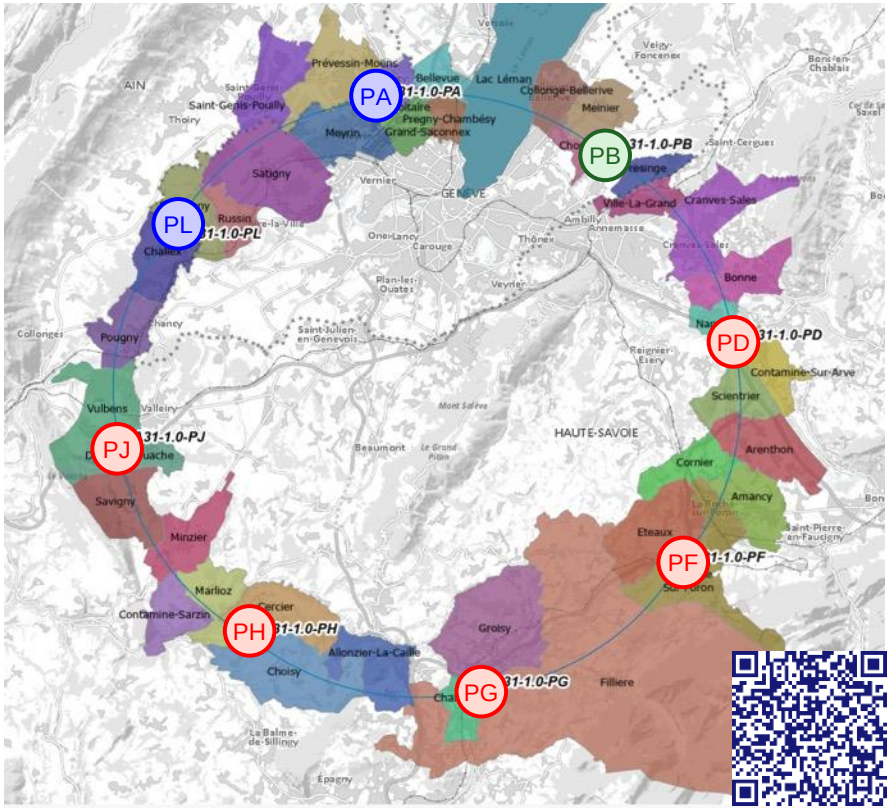
100 scenarios analysed and optimised with host state services and communes.

Reference scenario PA31:

- **Good scientific performance for both ee and hh** (4 IPs, 91 km, but sum of arcs with 78,7 km only 6% less than initial concept in 2014).
- **Better territorial performance than all other scenarios.**
- **Depth and inclination of alignment to be optimised with results of subsurface investigations after feasibility study.**

Reference scenario PA31

1. **PA – Ferney Voltaire** (FR, 01) – experiment
2. **PB – Presinge** (CH, GE) – technical
3. **PD – Nangy** (FR, 74) – experiment
4. **PF – Eteaux** (FR, 74) - technical
5. **PG – Charvonnex/Groisy** (FR, 74) - experiment
6. **PH – Cercier/Marlioz** (FR, 74) - technical
7. **PJ – Vulbens/Dingy en Vuache** (FR, 74) - experiment
8. **PL – Challex** (FR, 01) - technical



“Synthèse des contraintes et opportunités”, V2.0, Dec. 2023:
https://zenodo.org/doi/10.5281/zenodo.7569138
English version and updates in progress. To be published in autumn 2024.

France, Ain France, Haute-Savoie Switzerland, Geneva

Status of the scenario development

Placement of surface sites:

- All **site locations apart from PL** (Challex, Ain, France) **reviewed** with communes.
- No showstopper identified so far.
- Displaced **site locations proposed by Challex** were studied using cost-benefit analysis. Meeting with the commune planned in June to agree on definitive location.
- List of land plots for all sites and accesses in France (PA, PD, PF, PG, PH, PJ) transferred to region Auvergne-Rhône-Alpes for **registration of "prise en considération"**.
- **Land plot for site PB** in Presinge (Switzerland), **owned by Geneva**, is a protected agricultural zone. Rights can be obtained in the frame of a dedicated "federal sector plan" via equivalent compensation.

Procedure "Arrêté de prise en considération" for the purpose of "studying a public work or a development action"

- Registration of land plots by the "prefecture" of each department (Ain, Haute-Savoie) for 10 years.
- Public advertisement of the order in the concerned communes and at department level.
- If a request for an authorisation on the registered land plot is received, the decision will be put on hold for up to 2 years, non-renewable.
- Then, either the original authorisation is granted or a suspension of up to 1 year is issued to update the original request for authorisation that will then be granted.

Sustainability and key environmental aspects

Electricity consumption on average: 1.3 TWh / year
- In ballpark of CERN, ¼ of BASF Ludwigshafen plant (5.3 TWh) or 1 hyperscale data centre
- Renewable Energy Supply Feasibility Analysis (https://zenodo.org/doi/10.5281/zenodo.8074976)
- Construction with renewable energy set as the baseline.

Water consumption with 3 million m^3/year less than CERN in 2022.
- Feasibility with single intake from lake confirmed by local water supplier (SIG).
- Study being engaged to explore opportunities for use of wastewater (site PD).

Land surface needs reduced from ~ 100 ha with 12 sites to ~ 40 ha with 8 sites.
- No conflict with environmental protection zones. Fauna & flora analysed in 2023.
- In principle feasibility verified, land value estimated, agricultural economic loss estimated in 2024.
- Compensation actions to be developed with accompaniement of host states at later stage.
- Potentials for renaturalisation, wetland protection, biodiversity improvements identified.

Strategy for management of excavated materials (16.4 Mt over 8 years in 2 countries) developed.
- Entire volume can in principle be used for quarry backfill (valid for horizon 2030).
- To reduce CO_2 footprint, cost and nuisances, alternative approaches are being developed.

Sustainability and key environmental aspects

Waste heat:

- Potential to **supply > 30% of the heat** to local consumers (300 to 400 GWh/year)
- **Requires site-specific concept developments** to address most suitable consumers nearby and stimulate developments around the sites.
- **Requires** the development of an **adaptive operation concept**.

Carbon footprint:

- **LCA study for construction phase** launched with industrial partner to establish reference baseline.
- Optimisation of the civil engineering concepts as most effective way to lower carbon footprint.
- Carbon footprint is highly depending on local project implementation scenario. Therefore, study relies on specific resources and processes with EN 15804 Environmental Product Declarations (EPD).
- Results to be included in the feasibility study report.

Sessions Wednesday 08h30 – 12h00, Elizabethan C:
A. Guiavarch, “Waste heat supply opportunities”
D. Mauree, “Greenhouse gas production study of the construction”

Environment report: 2 Volumes

Non-technical presentation of the FCC and the environment it would be embedded in.
In french **for administrative services, the public and as basis for pre-project phase activities**.

Volume 1: Environmental aspects

High level descriptions of all infrastructures, collider and experiment subsystems.

Identification of aspects that may lead to noteworthy environmental impacts as far as the current level of concepts allow (**prioritisation**).

Functional descriptions of surface sites and needed territorial developments.

Description of the construction activities.

Description of the installation activities.

Volume 2: Environmental initial state

Non-technical presentation of **the FCC motiviation**, study and a potential project.

Environmental strategy and guiding principles for Ecodesign to be considered by infrastructure and equipment designers in pre-TDR phase.

Environmental analysis of perimeter:

- Climate, air, water, soil, geology, biodiversity, habitats, urbanism, mobility, economic activities, patrimony (cultural, architectural, archeological, natural), landscape, noise, vibration, artificial light pollution, radiation, natural risks, technical risks, potentially conflicting and synergetic projects.
- **Evolution of the territory without FCC**.

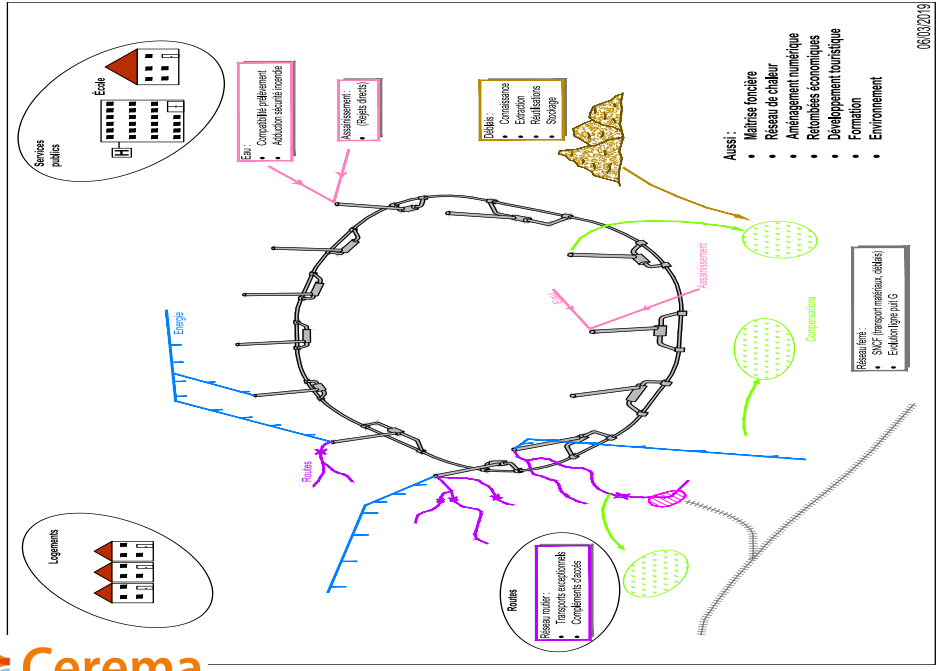
Conditions for environmental evaluation & environmental impact studies

1) **Project scope & distribution of study responsibilities** to be agreed with host states.

2) **Framework for the evaluation & authorisation** across and in the **two nations** to be established.

3) **CE design and construction process to be defined** (e.g. MATEX exit locations).

4) **Availability of adequate level of detail of technical requirements and designs that respond to them (plans)** of the elements for which impact studies and authorisation processes need to be carried out are to be documented.



Cerema

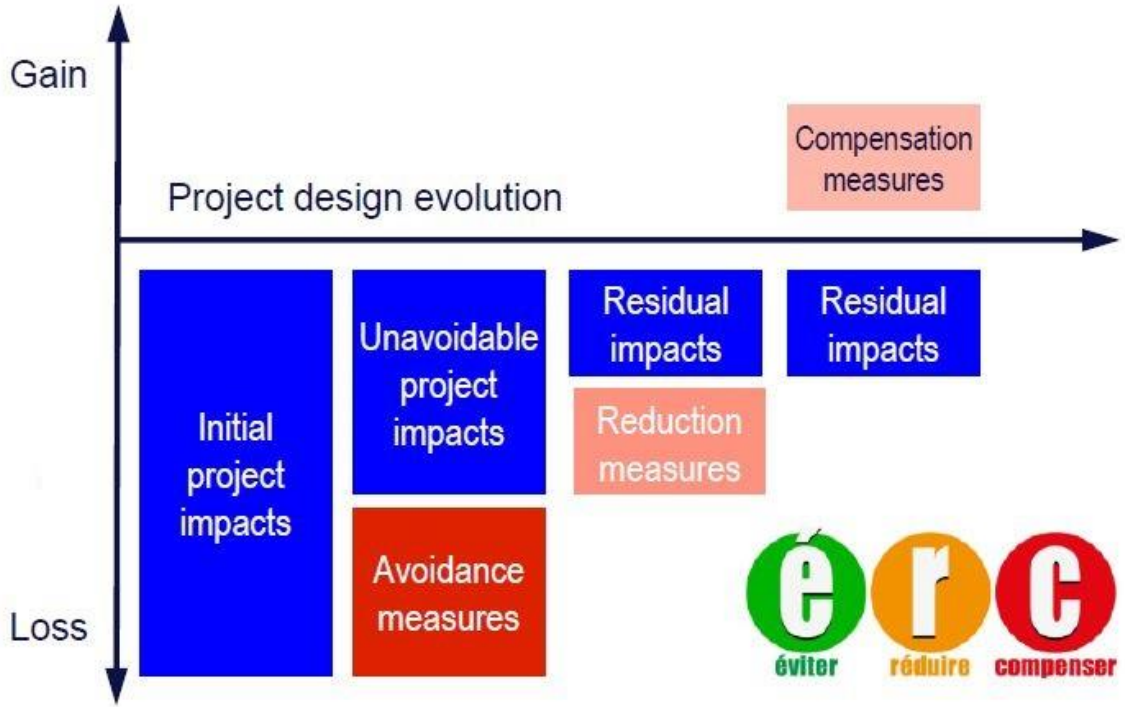
Regulatory principles applicable for FCC in France

Iterative 3 step approach:

Avoid: measures taken to avoid creating impacts from the outset or set aside key conservation areas / delete a potential impact

Reduce: measures taken to reduce the intensity and/or extent of impacts that cannot be completely avoided

Compensate: measures taken to compensate for any significant residual, adverse impacts that cannot be avoided, reduced and/or restored



Applicable for FCC in Switzerland

Principes de planification environnement (partie conceptuelle)

Indications contraignantes

- ***Eviter – réduire – compenser***
  Eviter toute atteinte, si cela n'est pas possible alors protection, reconstitution voire remplacement (applicables notamment aux milieux dignes de protection, art. 18 LPN)
  Cas échéant sécurisation des surfaces appropriées pour une compensation afin d'acquérir les droits nécessaires à ce sujet (processus analogue aux SDA)

- ***Variantes***
  Prérequis aux atteintes

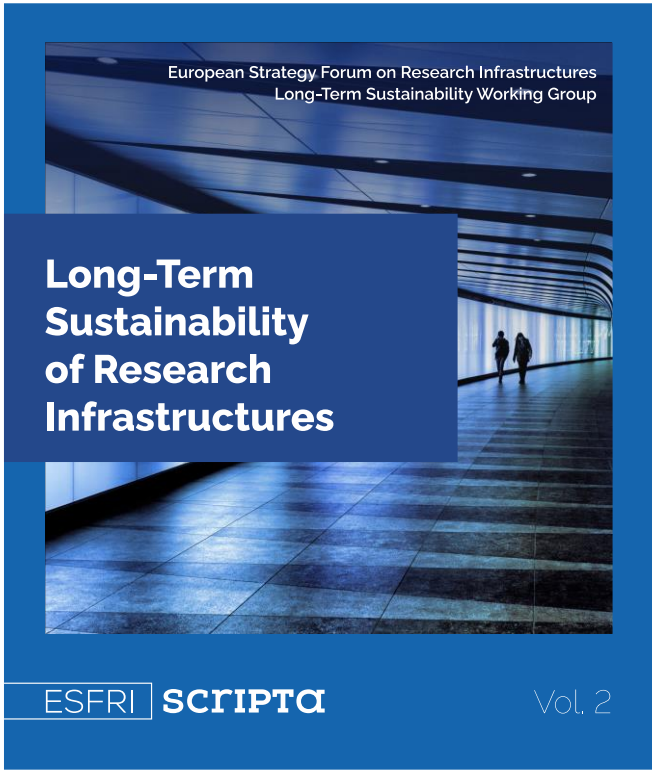
- ***Etat de la technique (voire au-delà; «best practice»)***
  S'orienter vers les meilleures pratiques, solutions et technologies disponibles.

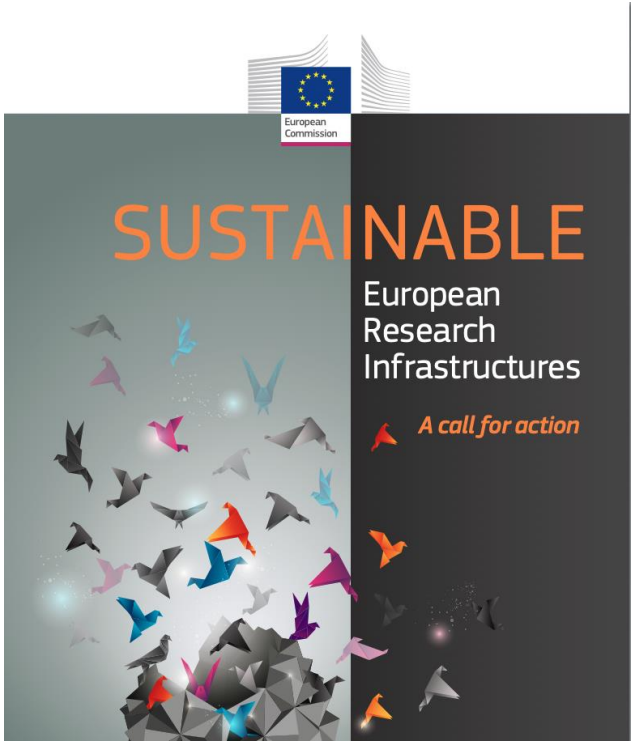
1) Avoid-reduce-compensate

2) Multiple scenarios

3) Evidence for state-of-the-art

EU basis for the FCC sustainability model

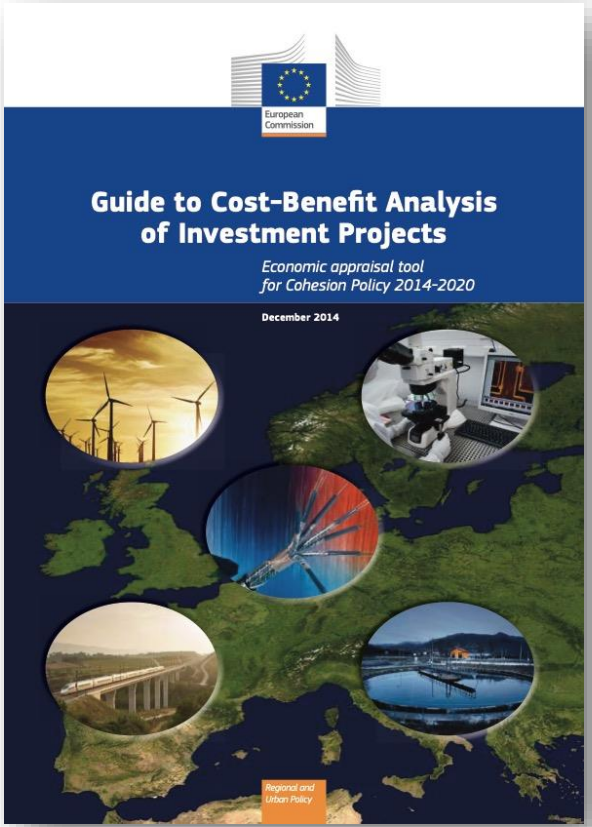


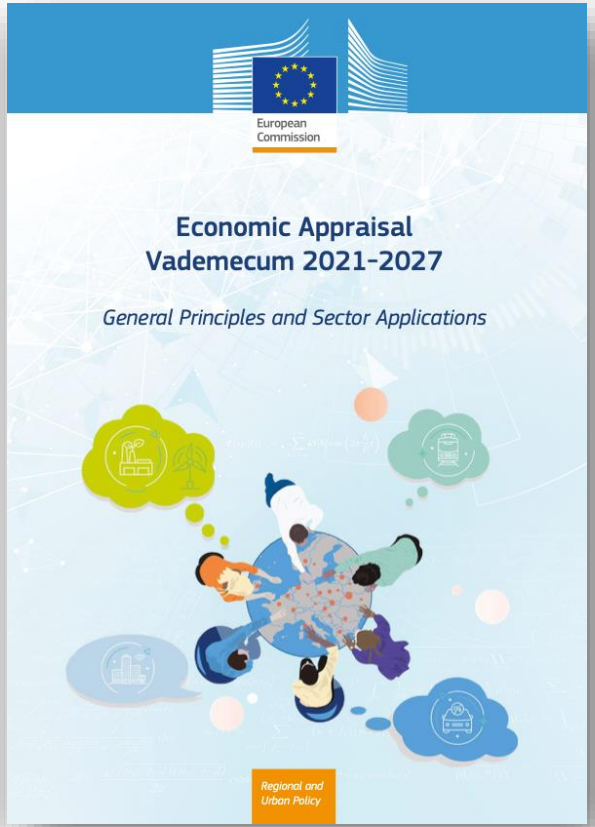


https://data.europa.eu/doi/10.2777/76269

https://www.esfri.eu/sites/default/files/ESFRI_SCRIPTA_SINGLE_PAGE_19102017_0.pdf

EU requirements for sustainability analysis





- All guides for Research Infrastructure investment projects foresee an **integrated social cost-benefit approach**.
- Required for loans.
- Required for inclusion in the European Strategy for Research Infrastructures.
- **Requested explicitly by France and Switzerland** in letters to CERN in 2024.

Progress on activities with communes

Meetings with communes:

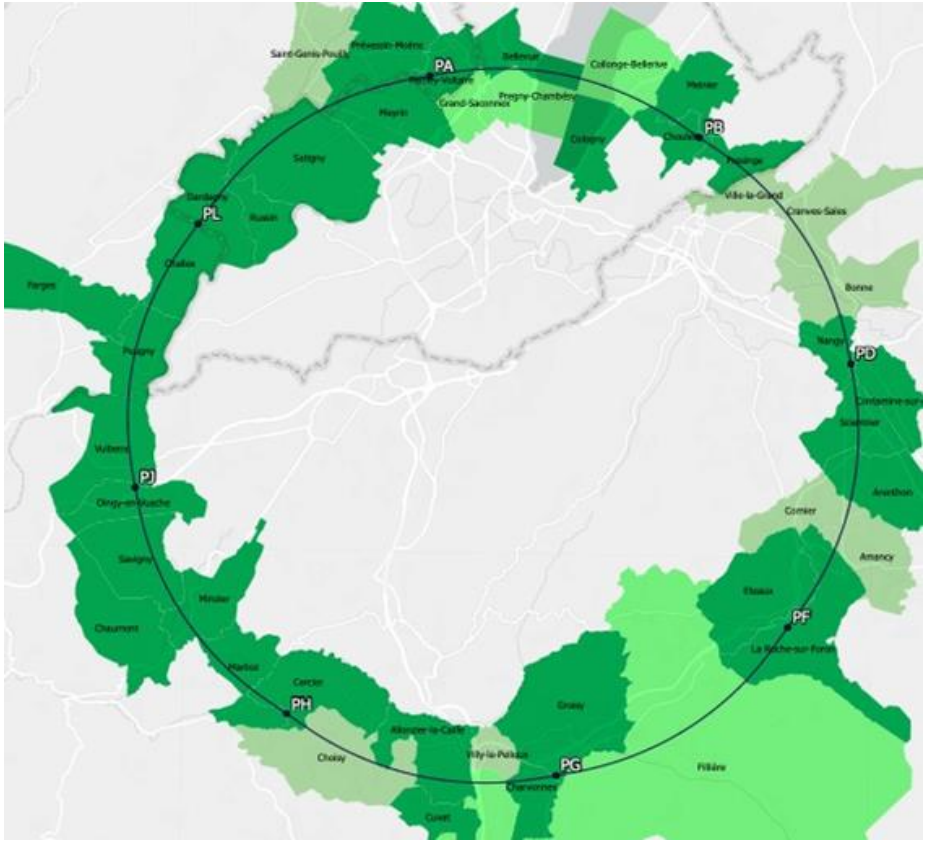
Meetings carried out several times with communes affected by surface sites to **optimise and verify the site locations**.

Meetings carried out with communes **affected by subsurface investigations** to clarify constraints and adapt locations.

Meetings done with local administations & operators of national parks **to clarify authorisation processes for investigations**.

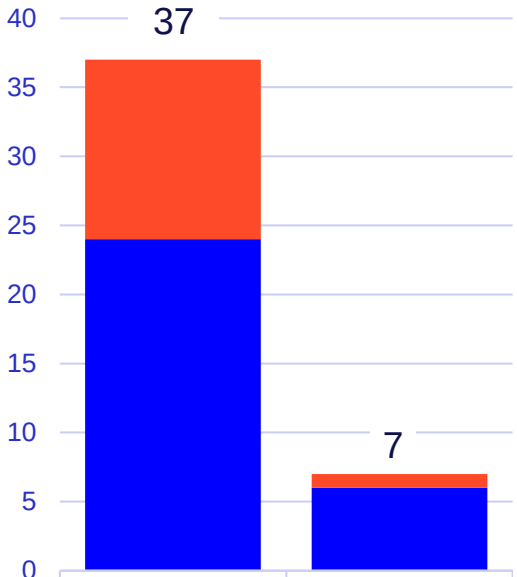
Feedback:

Communes **ask for public information events** to assure that the population is informed about the exploratory study, to receive clarifications about activities, locations and times of field investigations.



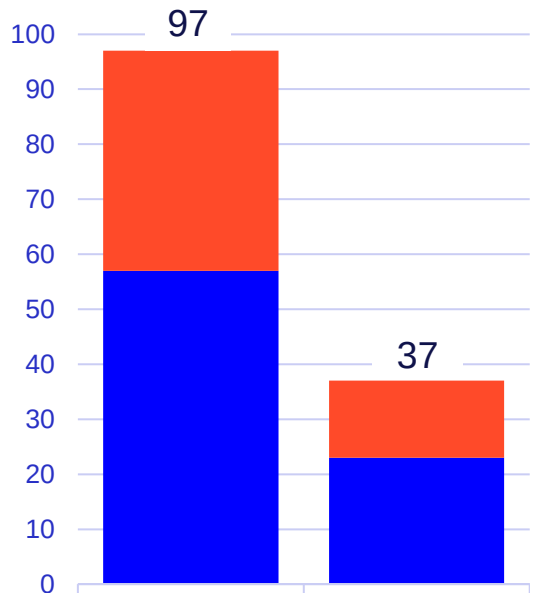
Meetings with territorial stakeholders 2023/24

Meeetings with communes



	2023	2024
Switzerland	13	1
France	24	6

Meeetings with local & regional stakeholders



	2023	2024
Switzerland	40	14
France	57	23

Measurement campaigns

Environmental field investigations ongoing until end of summer 24

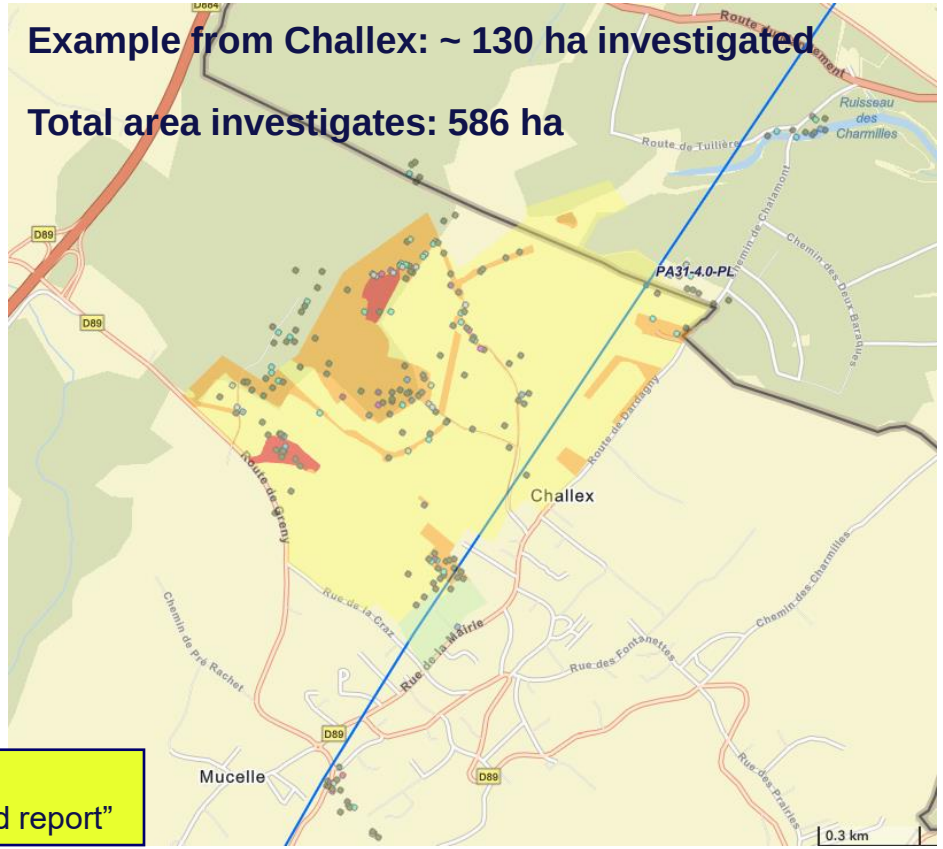
Site location optimisation being concluded with PL. Synergy and opportunity studies ongoing.

Seismic investigations foreseen for end of July 24

Geotechnical investigations foreseen for end of September

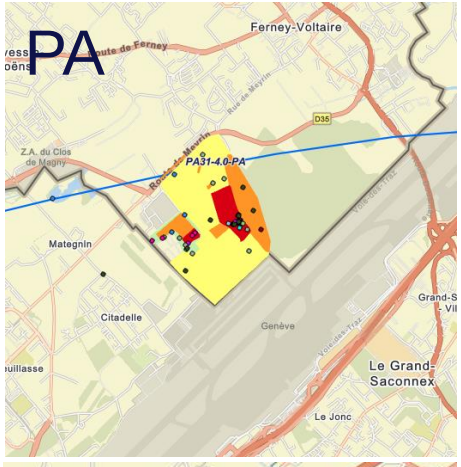
Progress on environment field studies

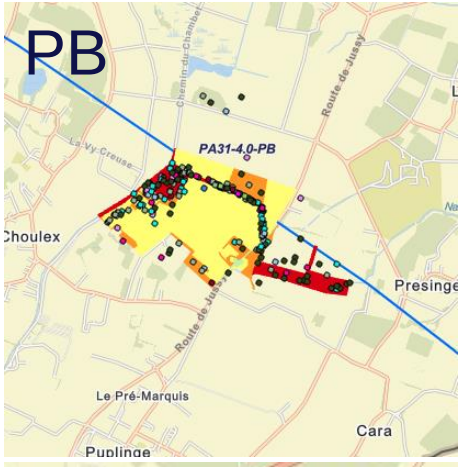
- **4-season field studies** for surface site location candidates completed
- **Landscape** analyses completed
- **Optimisation** of site perimeters performed
- **Soil analysis** is launched
- **Forest analysis** scheduled
- Background **noise measurements** scheduled
- **Air quality measurements** planned
- **Aerial imaging** scheduled
- Data continuously integrated in **Environmental Information System** based on ESRI ArcGIS

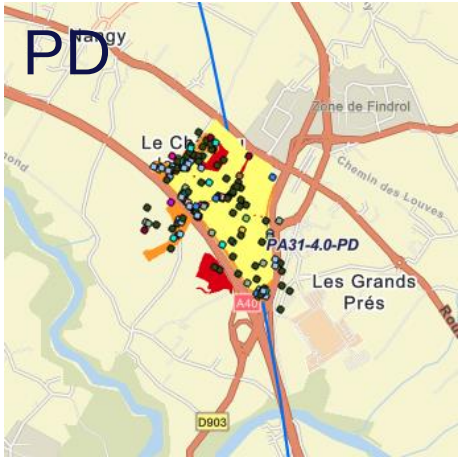


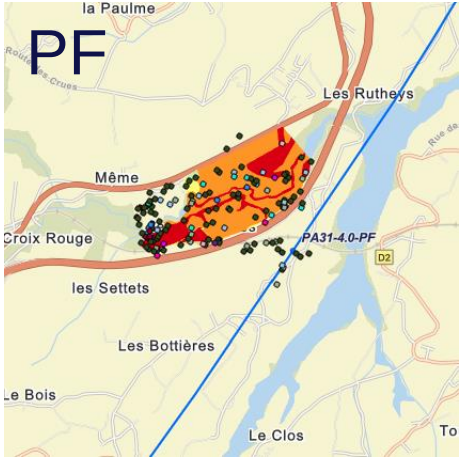
Sessions Wednesday 08h30 – 12h00, Elizabethan C:
D. Stagnara, “Status and progress of environment analysis and report”

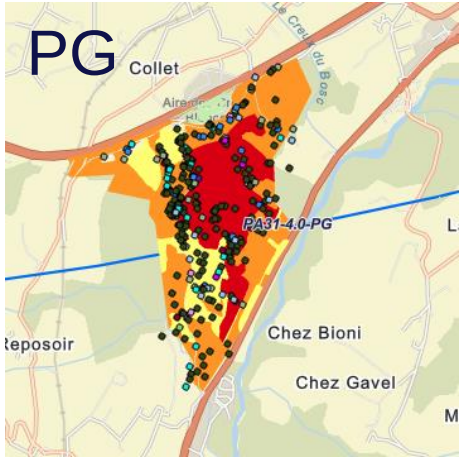
Total area investigated: 585 ha over 4 seasons

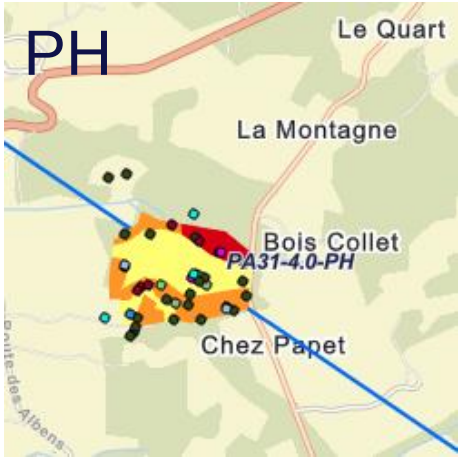


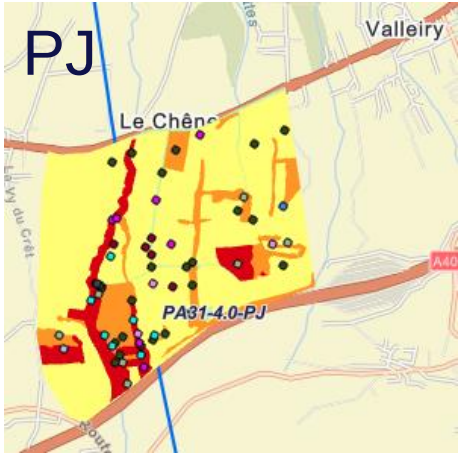


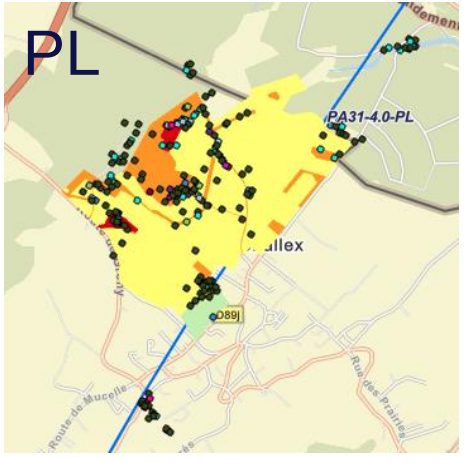




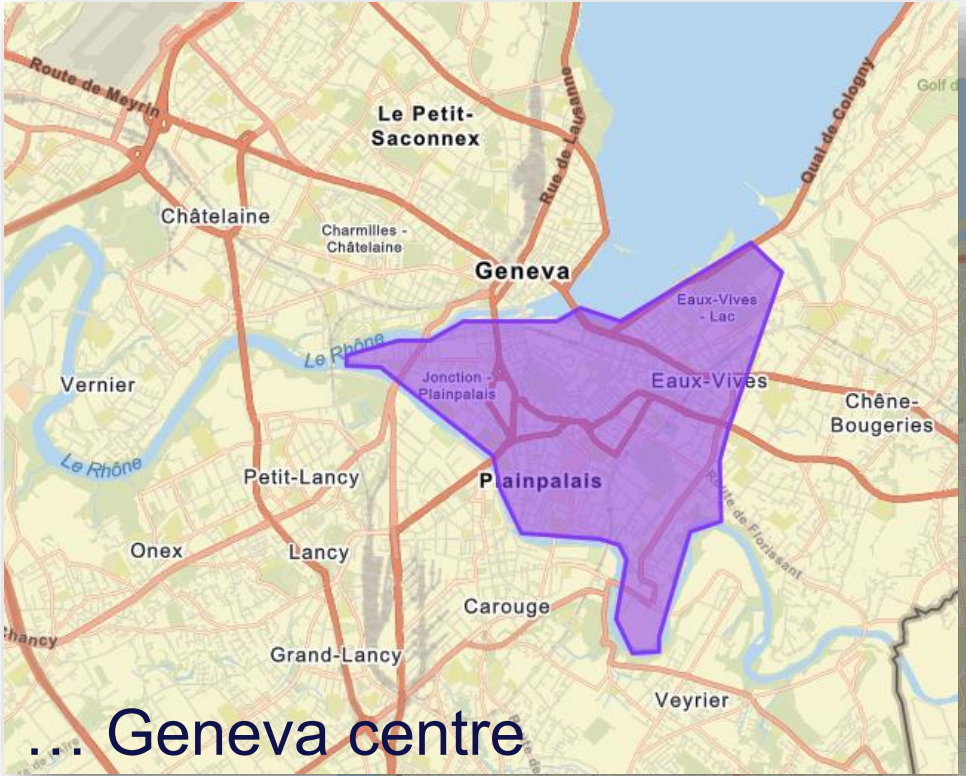






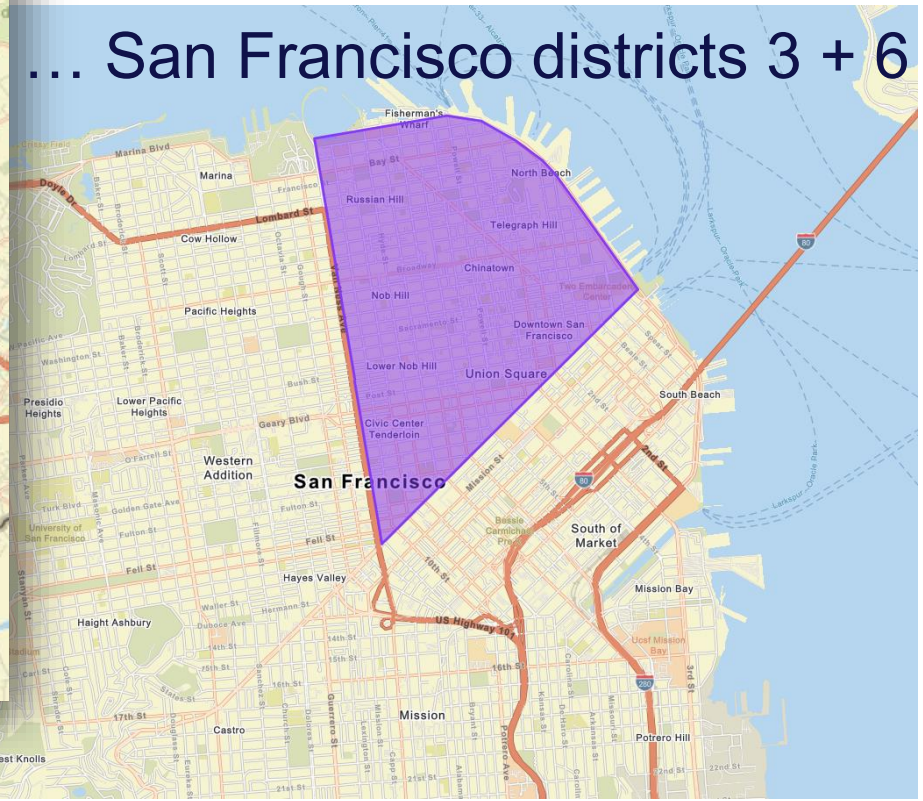


585 ha correspond to…



… Geneva centre

… San Francisco districts 3 + 6



Territorial studies

Land plot value

- **4 to 8 million** euro for all needed land plots.
- Value registered with public service in charge of registering real-estate values and real-estate taxes.

Agricultural study

- Initial state analysed and documented
- **0.58 million** euro of direct, upstream and downstream economic value loss estimated
- Direct validation with farmers being planned
- ERC measure development will follow

Forest study

- Methodology established and study ongoing

Site and road accesses

- PB, PD, PF studied at technical concept level.
- PG, PJ requires improvement of existing access.
- Access for PA direct.
- Access for PL to be consulted with host state once final location agreed with Challex.
- Accesses to highways for PD, PF, PG, PJ studied by Cerema and considered technically and administratively feasible.

Electricity

- Feasibility studied for operation (400 kV) and for construction phases (local supplies).
- Technical designs for a subsequent phase in close cooperation with host states needed.

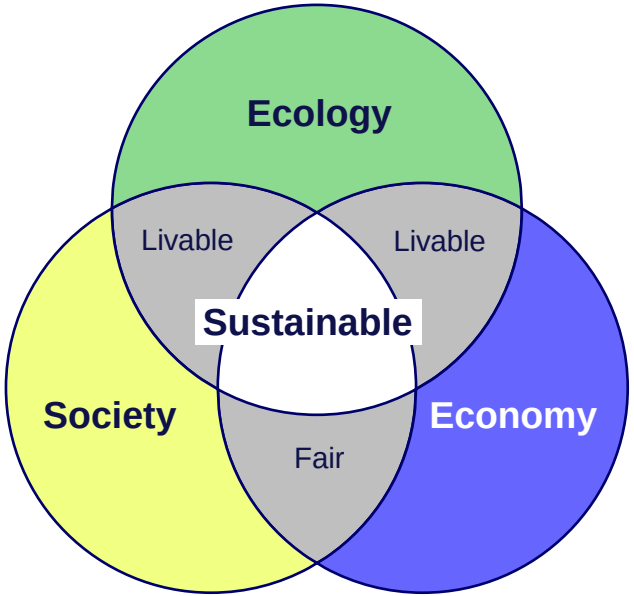
Progress on impact studies

Comprehensive socio-economic impact analysis is requested explicitly by both host states in writing and by the EC.

Is the methodology to determine the long-term sustainability of the research infrastructure by estimating the **Net Present Value**, the **Benefit/Cost** ratio and the Internal Return Rate.

Contents:

- **full cost** (CAPEX + OPEX) - integrated
- **positive impact potentials** - integrated
- **negative externalities** and additional positive impacts will be integrated until the end of the study – to be integrated



Results so far: Benefit/Cost ratio = 1.66

Report Version 1.0:
https://doi.org/10.5281/zenodo.10653396

Sessions Wednesday 08h30 – 12h00, Elizabethan C:
J. Gutleber, “Results of the socio-economic impact study”
R. Crescenzi, “Harnessing Big Science, Expanding CERN’s global impact through strategic policies”
L. Alix, “Results of the pole analysis study”
C. Staudinger, “The OpenSkyLab for innovating excavation materials re-use”

Outreach and engagement

Development of language elements, questions and answers in view of public information meetings.

Information materials in French language to support the subsurface and field investigations consolidated.

Motion design:

- https://cernbox.cern.ch/s/oUMFZ7cz4pQWBw5

Brochures in french:

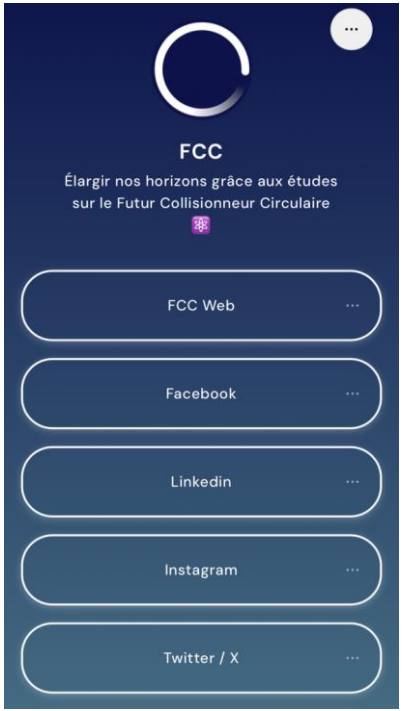
- https://fcc-faisabilite.eu/documentation

General brochures:

- https://fcc.web.cern.ch/media

http://fcc-faisabilite.eu

We are open and respond to people's questions!



SCAN ME

QR code for email address
fcc-info@cern.ch

Address open to the public **to ask questions about the FCC studies**.
Proper tracking of questions and responses with ServiceNow@CERN.

https://linktr.ee/FCC_study

Respond on social media to make sure correct figures and facts circulate.

Event tracker – some examples

RTS radio show on 15 May

Presentation of FCC to the public
at CERN with discussion on April 24

Visit of SRB water syndicate
(site PD) on 17 April

FCC booth during
La Roche-sur-Foron Expo from April 27 to May 6