

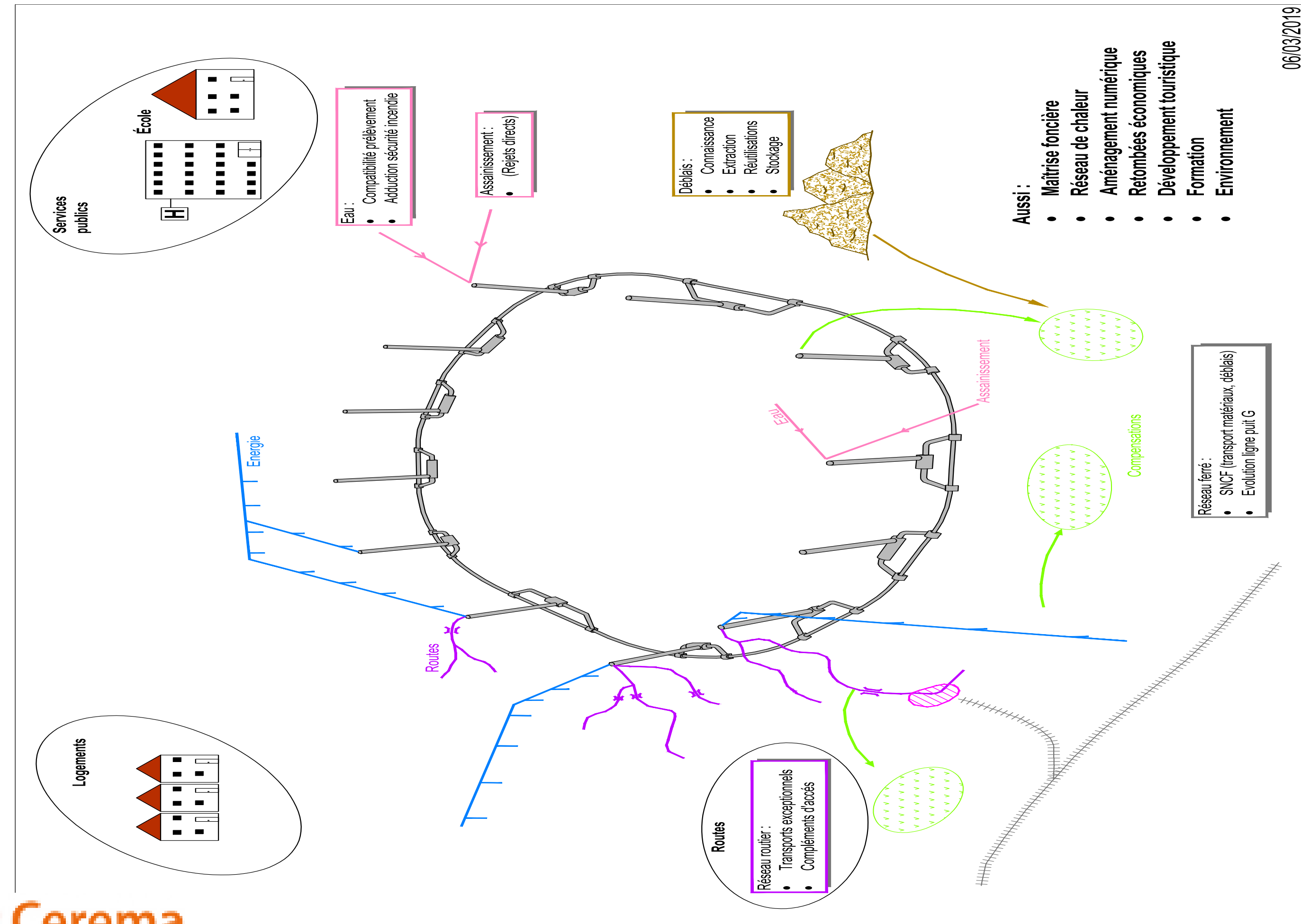
INTEGRATE EUROPE (WORK PACKAGE 3)

Johannes Gutleber (CERN)
2020-11-09, 14h00-14h20

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the European Union's Horizon 2020 research and innovation programme under grant agreement No 951754.

Scope of the FCC Project

- Legal frame in Europe (EC 2011/92/EU) in general and in France (Code de l'environnement art. L. 122-1 & R. 122-2) in particular require the project to be understood in a large sense*.
- Preparatory work for FCCIS developed the project scope together with french and swiss host state partners.
- “Entire project” is composed of sub-projects with different project owners.
- Three main projects are relevant:
 - **FCC Research Infrastructure (FCC RI)**
 - Injectors, particle collider, experiments, technical infrastructures, sub-surface structures, surface sites and all directly required construction works
 - **“Development project in France”**
 - E.g. roads, electricity lines, water supplies and other infrastructures required for the functioning of the RI, development of community services for health and safety, regional developments
 - **“Development project in Switzerland”**
 - See examples above



*<http://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/qu-est-ce-qu-un-projet-a12407.html>

Objectives of the work package with respect to Description of Action (DoA)

Motivation: To be feasible, both a territorial implementation scenario that is societally acceptable and the required performance for scientific research need to be delivered.

Contribute to project objective 2: Demonstrate the technical and organisational feasibility of a 100 km long, circular particle collider.

Optimise the layout and placement of the infrastructure as result of implementing a standard environmental management process.

Deliver a territorially implementable project scenario, validated by key stakeholders.

Contribute to project objective 5: Demonstrate the role and impact of the research infrastructure in the innovation chain, focusing on responsible resource use and managing environmental impacts.

Showcase responsible resource usage through a management plan for waste reduction and re-use pathways that include competitiveness opportunities for constructors, as the aims in the H2020 work programme states.

Links to other work packages:

- WP 2 technically optimises the collider design.
- WP 4 integrates socio-economic aspects.

Pathways to achieve the objectives

Optimise the collider and infrastructure layout and placement in cooperation with French and Swiss partner authorities.

Include the **study of resource efficiency** and the management of socio-urbanistic and environmental aspects.

Develop a plan to manage the ca. 9 million m³ of excavated materials

Run an international challenge-based competition to identify innovations* in the area of molasse re-use called “Mining the Future[®]”. This open innovation initiative aims at strengthening the European engineering industry and make sub-surface engineering projects in general more resource and cost effective.

Develop the **concept for the environmental evaluation in a transnational context** that directly leads to the **construction authorisation** in both host states.

Develop the process for the environmental evaluation that includes the approach for an **iterative optimisation** of the collider placement, incorporating environmental management (EN 14001) and eco-design (EN 14006) norms.

Document the electrical power requirements and identify reduction potentials (outside scope of project)

Document the natural resource needs (water, soil) and identify **potentials to reduce** them (outside scope of project)

*Innovation is the creation of new products, processes and services

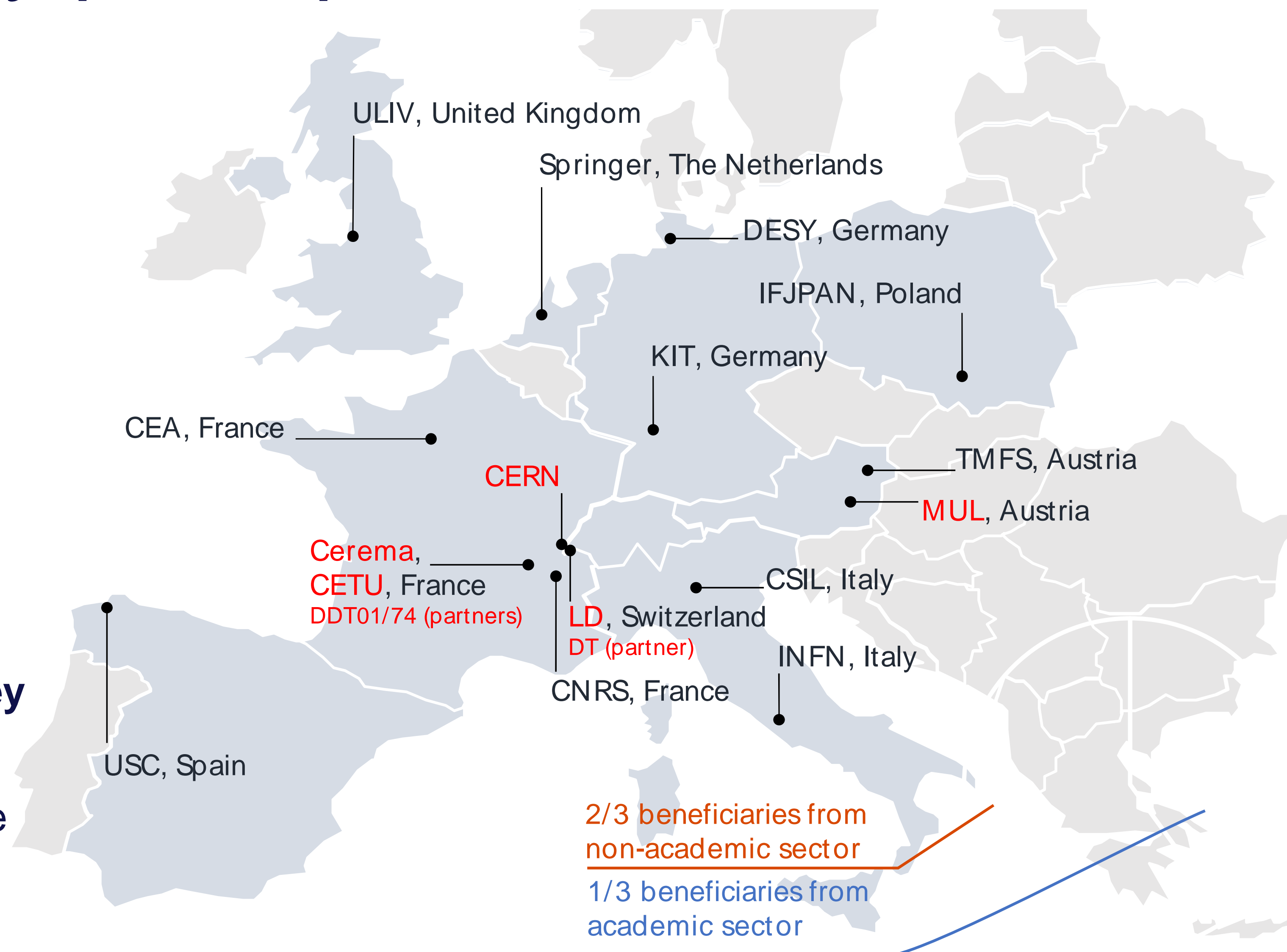
Work Package key participants

Participants in lead roles:

- **CERN, IEIO (WP lead)**
- **Cerema, France (WP co-lead)**
- **CETU, France**
- **LD, Switzerland**
- **MUL, Austria**

Work carried out with partner organisations in the two CERN host states ensure that the territorial analysis and optimisation engages key stakeholders from the beginning on.

Concertation structures for this setup are put in place at CERN directorate level.



WP3 key participants



Lyon-based (France) “Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement” is a public institution to supports the implementation of public policies under the dual supervision of the Ministry of Ecological Transition and the Ministry of the cohesion of the territories. Maintains relations with the local authorities.



Lyon-based (France) “Centre d'Études des Tunnels” is a central technical service of the Ministry of transport. Its competences include all aspects relating to the management of all lifecycle phases of tunnels, notably providing assistance to project owners. Participates in standardisation bodies.



Leoben (Austria) based university with extensive experience in national and international tunneling projects and excavation materials re-use projects. Participates in international CE project guideline developments.



A Geneva (Switzerland) based company that accompanies regional projects and project owners for environmental, urbanistic and administrative procedure developments. Contributes with working relations to DT in Switzerland.

Setup of work with Host States

Switzerland

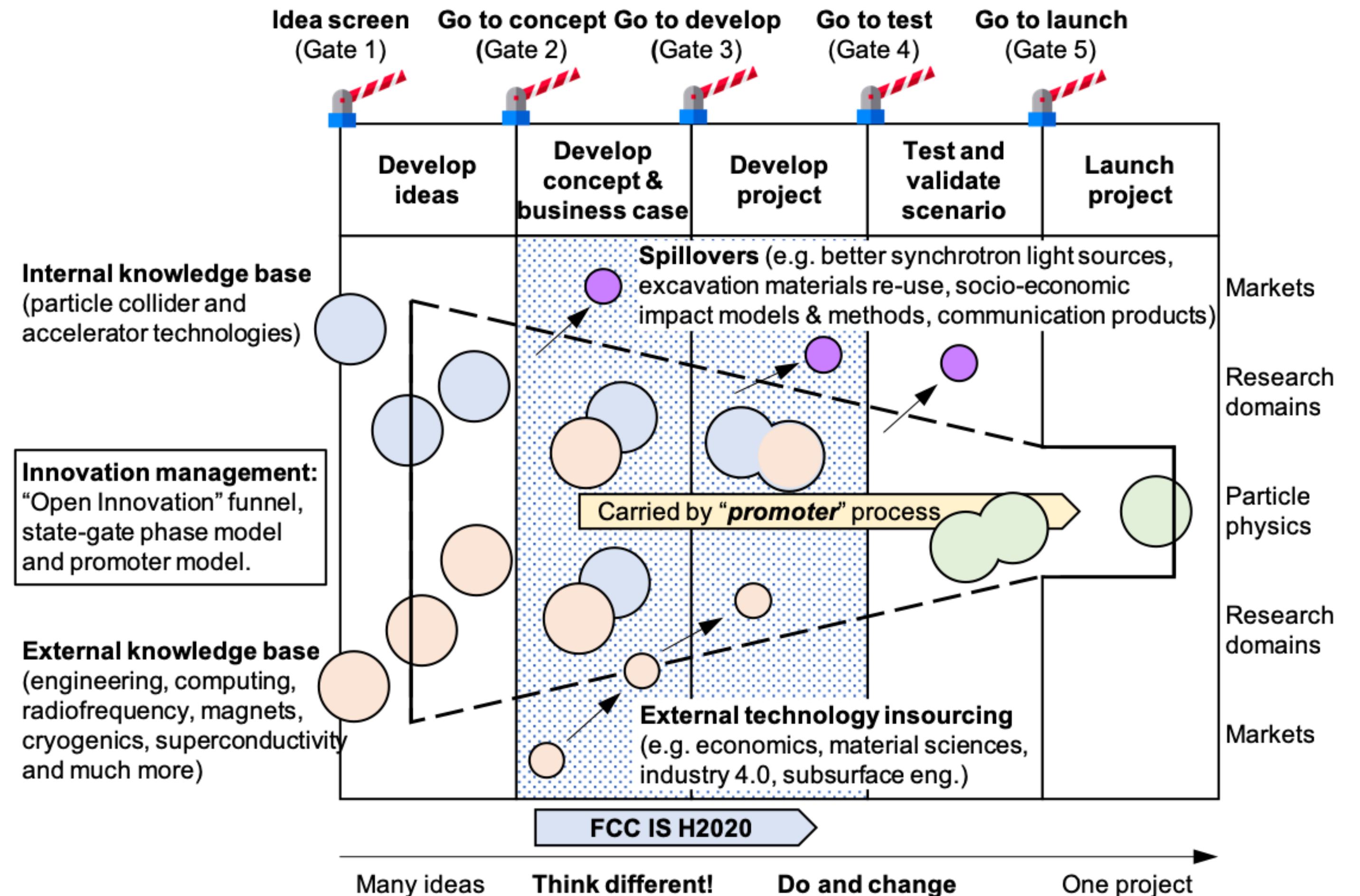
- **Structure de Concertation Permanente** with representatives of the **confederation** (DFAE), **permanent mission** of Switzerland at the international organisations and the **state of Geneva**.
- Dedicated sub-working groups with the **Département du Territoire** (DT) with representatives of different cantonal zones.
- Cantonal office of Agriculture and Nature (**OCAN**).
- Service of geology and waste (**GESDEC**).
- Service of environmental and major risks (**SERMA**) as the body notified by the federal office for environment as primary contact for FCC environmental evaluation matters.
- Different entities for targeted inquiries (e.g. commission foncière agricole, airport Geneva, SIG, lawyer offices concerning land ownership status, environmental experts for topical inquiries and many more).

France

- **Cerema and CETU** as **decentralised public bodies** accompany large scale projects in France for work on the high level territorial optimisation (integration point of information from different national, regional and local sources) and as the bodies that instructs about environmental and territorial requirements for surface and subsurface investigations (water, risks, waste, agriculture as required by different laws). Facilitate the compliance with the project owner's requirement with respect to administrative processes.
- **Prefecture de la région in Lyon as representative of the french state** (Secretariat General) for transversal integration of topics (placement, excavation materials, environmental evaluation, administrative processes and processes involving the public, link to departments). Link with DREAL (Direction régionale de l'Environnement, de l'Aménagement et du Logement).
- **Direction départementale des Territoires (DDT)** for Haute Savoie (74) and Ain (01) for the micro-optimisation of retained scenarios. This link will be established in December and a dedicated working group will start in 2021, mandated by the préfet of the AuRA region.

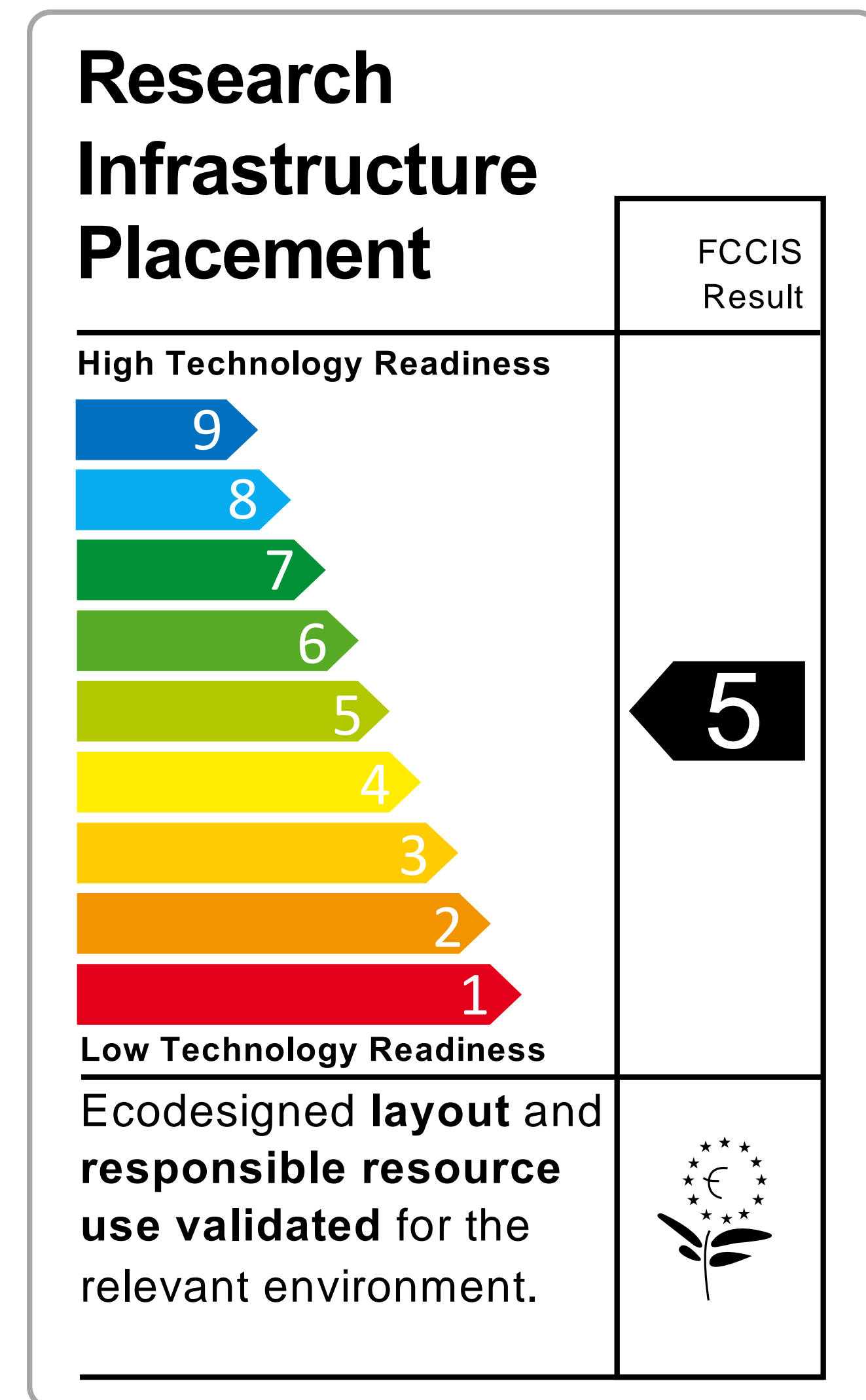
Open Innovation management in WP3

- **“Open innovation”** means that by the main project, the particle collider research infrastructure development **“technology in-sourcing”** and the **“generation of spillovers”** is fostered from the very early project phase onwards.
- Aims at **advancing the work on the feasibility** of the main project.
- Aims at **creating added value for the economy and society**.
- Case ins WP3 is the excavation materials challenge.



Positioning of the WP3 matex management plan

- Based on the CERN-organised “matex” working group activities between 2016 and 2018 on establishing a guideline for the plan to manage the FCC excavation materials, **develop the contents of the management plan.**
- **Aim of the plan: show the feasibility of the project** with respect to managing the excavated materials and that the relevant upcoming questions are appropriately addressed (focus on avoidance of landfills)
- Includes all **aspects related to plan and carry out the excavation materials related tasks** from the site investigation onwards, over re-use development cases to contracting of the CE project and the processes required during the construction.
- Does not specify all the detailed individual re-use cases, which require a more advanced project design (specific locations, detailed analysis of regional capacities, more detailed tunneling process designs, financing and schedule plans, environmental policy and voluntary commitments, analysis of the legal conditions and potential changes of the legislations). Includes, however, the analysis and development of the fundamental pre-requisites.



Positioning of the Mining the Future[®] challenge

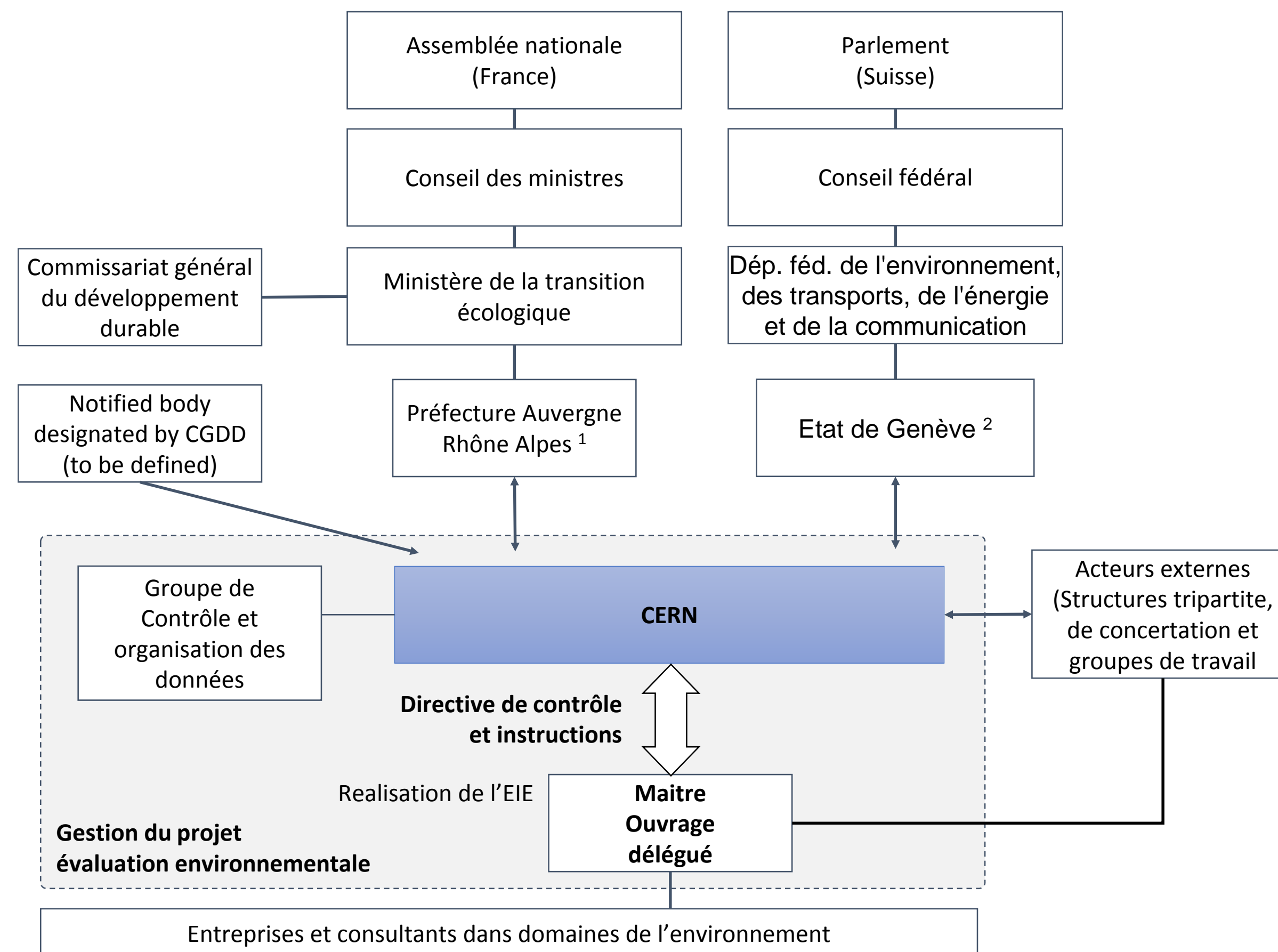
- **Molasse is a heterogeneous, sedimentary material.**
 - The prevalent excavation material encountered in the FCC subsurface project.
- **For molasse no socio-economically viable re-use process at industrial scale is known today**
- **Objective: identify solutions to create value from molasse and to avoid landfill**
 - Through that process demonstrate the capability of a large scale research infrastructure project to generate relevant socio-economic benefits.
- **Solicits an international community of individuals, academic organisations and companies to propose credible re-use processes.**
 - Identify viable technology candidates or confirm that alternative strategies remain to be developed.
- **Require process demonstration at laboratory level and evidence for deployment technology-readiness by 2030.**
- **For the winner, the award contributes to the technology, business plan or IP development and creates visibility at international level.**

Mining the Future[®] MATEX Challenge

	FCCIS Result
<p>High Technology Readiness</p> <p style="text-align: right;">Low Technology Readiness</p>	<div style="font-size: 2em; font-weight: bold; background-color: black; color: white; padding: 10px; width: 40px; margin: 0 auto;">4</div>
<p>Molasse re-use processes surveyed and potential approaches identified with laboratory validation.</p>	

Environmental Evaluation Framework

- **Environment = all topics that the project affects.**
 - Includes for instance nature, land, urbanism, public health and safety, economic losses and benefits as well as impacts across national borders.
- In **France**, environmental evaluation is a **process anchored in the the law** (R.122-5 code de l'environnement) to show that the project is planned such that the possible impacts to the environment are managed according to the “**avoid-reduce-compensate**” approach.
- In **Switzerland** (federal ordonance OEIE and cantontal regulation concerning the adoption of the OEIE K 1 70.05) the process aims at **showing that the project satisfies the requirements of the applicable laws.**
- **Proposal of one single integrated process for the entire project in both host states** is an appropriate concept.
- The environmental evaluation **leads in both host states to the necessary authorisations of the project.**
- This project will develop and deliver the concept for the integrated process that is the pre-requisite for its implementation.



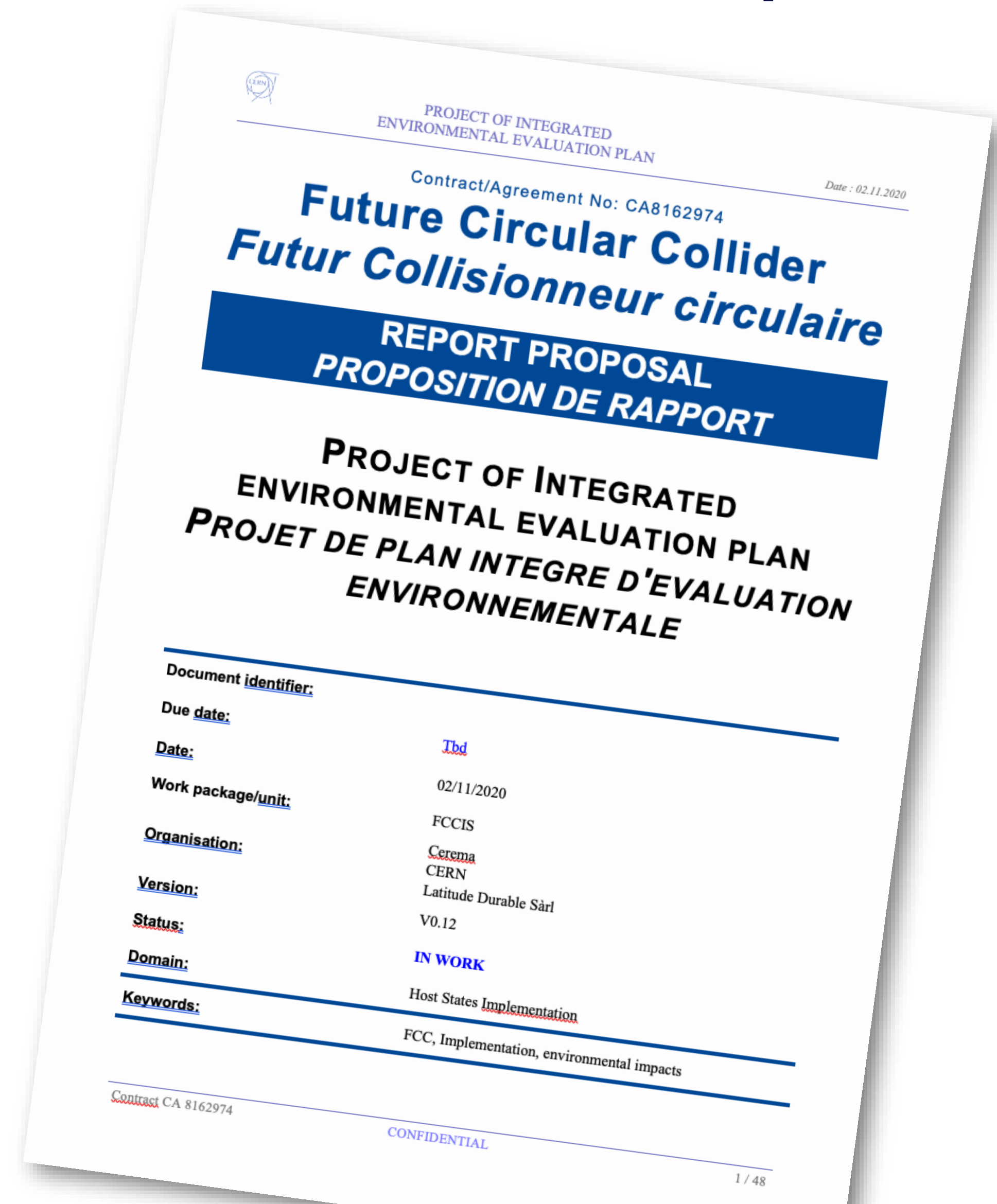
¹ Représentée par le Préfet de région

² Représenté par le Département du territoire (DT – OCEV – SERMA)

The environmental evaluation concept development includes the drafting of an appropriate organisation structure for this process.

Work on Environmental Evaluation Concept

- Preparatory work on deliverable has started in 2020.
- Document will be the basis for
 - Planning of the environmental evaluation project plan
 - Work on the project schedule
 - Environmental evaluation resource and cost estimates
- Basis for review of the concept with the environmental authorities in both host states
- Serves the establishment of an informal concertation process with the host state environmental authorities for the first phases of the evaluation
 - Project scoping
 - Project owner and responsibility mapping
 - Stakeholder mapping
 - Initial state analysis and recording



Tasks

- **T3.1: WP coordination (CERN)**
- **T3.2: Placement optimisation (CERN)**
 - Involves several beneficiaries such as Cerema, CETU, MUL, LD to arrive at an integrated approach
 - Involves notified bodies of the region Auvergne-Rhône Alpes (DDT74/01), France
 - Involves Etat de Genève (DT sector representatives, OCAN, GESDEC, SERMA), Switzerland
- **T3.3: Transnational environmental evaluation framework (CERN)**
 - Concept development driven by Cerema (France) and Latitude Durable (Switzerland)
 - Integrates input from other beneficiaries, e.g. CETU on the management of excavated materials
 - Notified body in France is the regional government (Prefecture Auvergne-Rhône-Alpes) who assures the establishment of relevant working links in the host state.
 - Analyse with the “Commissariat général au développement durable” (CGDD) requirements for an informal study phase before engaging the formal process as foreseen by law for large projects.
 - Notified body in Switzerland “Service Environnement, Risques Majeurs et Accidents” at cantonal level delegated by the federal office for environment for planning an informal study before engaging a formal process
- **T3.4: Management of excavated materials (MUL)**
 - Working group moderated by CERN
 - Co-operation with notified bodies in France (CETU, Cerema) and Switzerland (GESDEC)
 - Carry out an international challenge-based competition to identify molasse re-use innovations (innovation = a new product or service for the market)
 - Forges strategic partnership with notified bodies and projects with similar characteristics (e.g. Koralmtunnel, TELT)

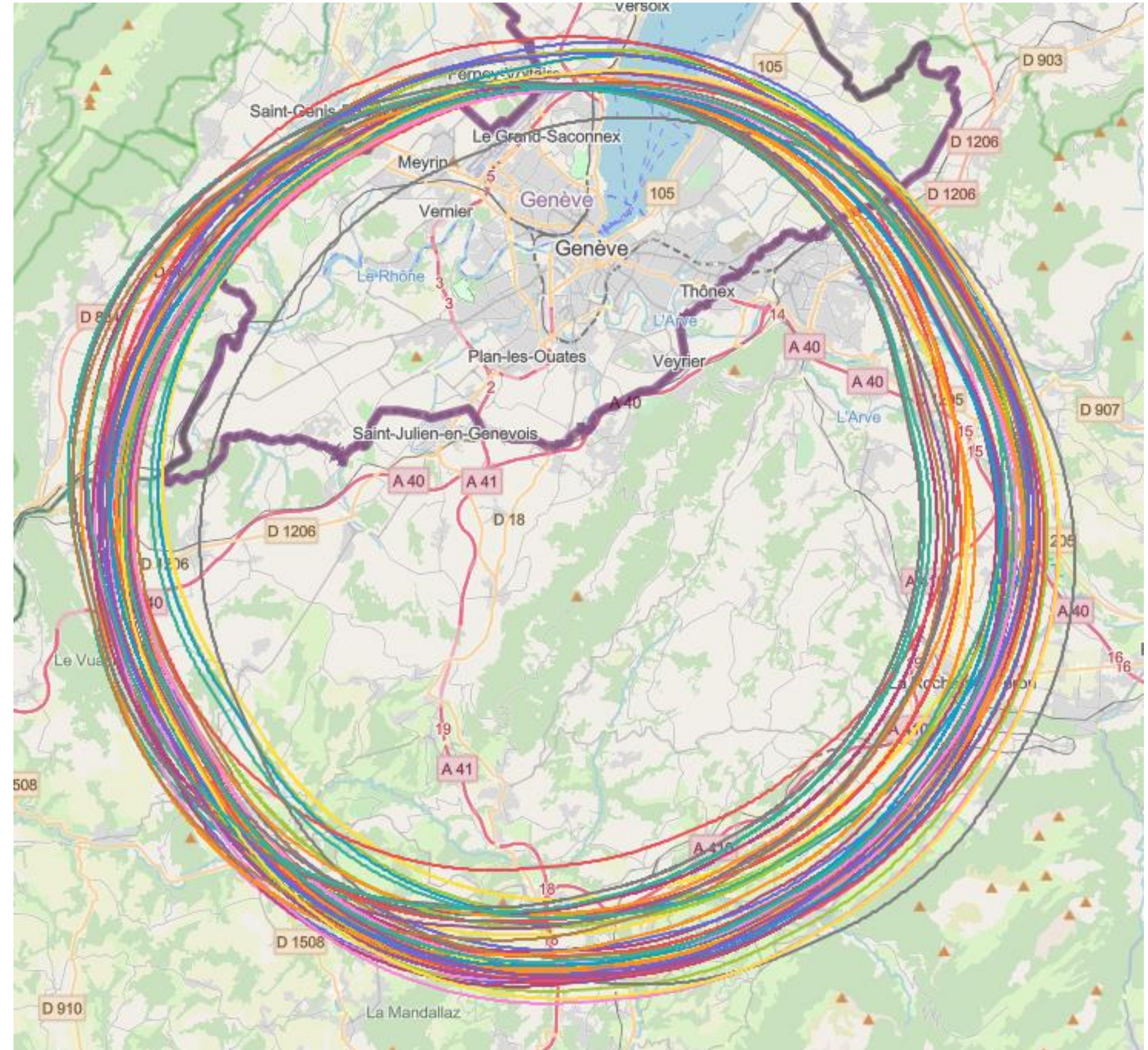
Deliverables and Milestones

M/D		Status	Month	Date
MS2 (3.1)	Mining the Future [®] challenge call open	Not started	5	March 2021
D3.1	Transnational environmental evaluation requirements and framework	In progress	16	March 2022
D3.2	Mining the Future innovation challenge results	Not started	24	October 2022
D3.3	Particle collider layout and placement assessment	In progress	34	Sept. 2023
D3.4	Preliminary excavation materials management plan	In progress	45	Aug. 2024

Work in practice

To comply with EU and French law for the environmental evaluation process, the placement work follows an iterative process, applying the approach “reduce-avoid-compensate”.

- 1) **Establish a harmonised catalogue of territorial conditions for France and Switzerland considering national and regional conditions** (urbanism, nature, geological and hydrological situation, natural and technical risks, etc.)
- 2) **Apply the “reduce” approach to determine a set of potentially feasible baselines for further optimisation (immediate next step).**
 - Includes work with national „notified bodies“ at a high level down to local urbanistic planning
 - Includes review of FCC technical matters such as collider beam optics constraints, civil engineering constraints, technical infrastructure constraints



So far, 45 scenarios out of hundreds were individually looked at and retained for further optimisation at micro-level.

Tool development for more efficient exploration

New **Web App** produced by CERN (V. Mertens) in 2020.

- Permits to **vary machine** and **geographical parameters** and **display** the resulting **access point positions in real time**.
- Various **base map types** and various **additional layers** can be selected.
- Allowed to **massively speed up exploration** of allowed parameter space and find first match with territorial constraints (compared to available tools)

Following that first step, results are output for further processing (transfer to ArcGIS, detailed site description/analysis, micro-optimisation).

Select base layers and overlays

Constraints maps

Vary machine and geographical parameters

For chosen parameters, check point positions in real time

FUTURE CIRCULAR COLLIDER STUDY

Input parameters

S_ARC cells (8-30)	19
L_ARC cells (62-84)	73
# S-L ARC cells linked	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
LSS_A, B, length [m]	1400
LSS_D, J length [m]	2600
Fixed point	<input checked="" type="radio"/> PA <input type="radio"/> PB
LON_X [xx° E]	6.0576
LAT_X [xx° N]	46.2358
Azimuth_X [xx°]	26.4

Resulting parameters

S_ARC length [m]	4716.519
L_ARC length [m]	16221.023
Sum ARC lengths [m]	83756.170
Sum LSS lengths [m]	14000.000
Total length [m]	97750.170
# RBENDs	4672

Resulting parameters (ext.)

Parameter sets

File download

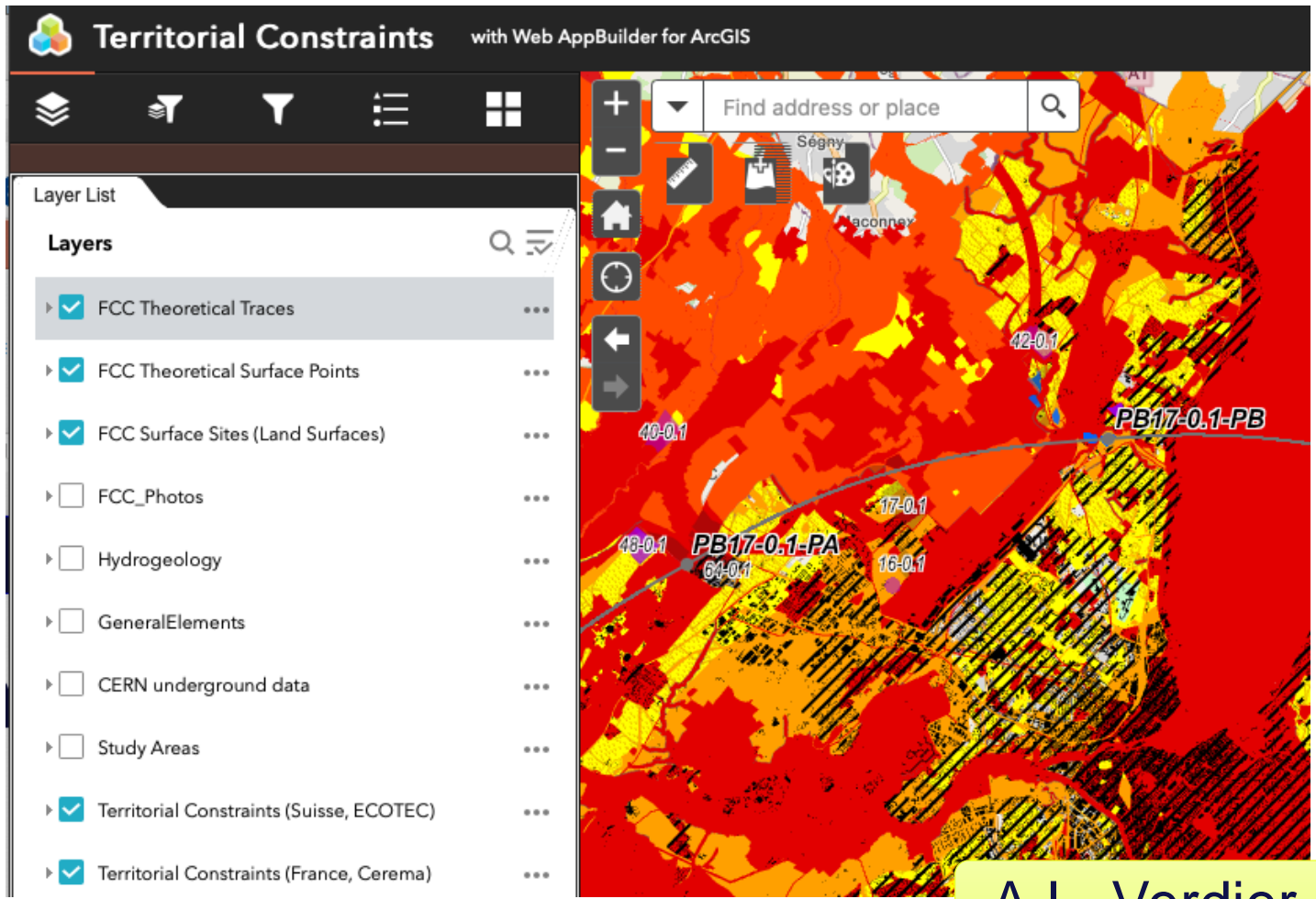
Messages

22:17:40 FFE2 01beta (3.6.2020)
 22:17:40 Load CH constraints syntheses (SITG)
 22:17:40 Load FR constraints syntheses (Cerema)
 22:17:40 Load FCC trace
 22:17:40 Load LHC trace
 22:17:40 Load "Zones of interest" (Cerema)
 22:17:40 Load TOT boundary
 22:18:12 Open help window

V. Mertens

„Assisted pre-search“ (additional module varies machine parameters automatically within chosen limits and outputs candidate scenarios with enough hits in target zones for manual optimisation).

Preparatory work on documentation framework



GIS system for information integration

Site Description Information Sheet		Site Name:	PB	Version:	PB13-0.1-PB-0.1
Document identifier	FCC_2007071000_AVE_SiteDescriptionInformationSheet_PB13-0.1-PB-0.1	Land Surface Name:	91-0.1		
Date:	2020-10-14	Doc. Version:	0.4		
Approved by:	Last name, first name, organisation	Approval status:	IN WORK		
Created by:	Verdier, Anne-Laure, CERN	Approval date:	YYYY-MM-DD		
E-mail:	anne-laure.verdier@cern.ch	Phone:	+41 75 411 5106		
Geographic location:	Lambert 93 Easting: 940403.6m Northing: 6578233.4	WGS84 Lat: 46.26120003 Long: 6.12190054	LV95 Easting: 2498478.3719m Northing: 1124161.776m		
	Town: Bellevue	Canton or Département: Genève	Country: Switzerland		
	Parcels, owners, classification (PLU, PD): 371, 376, private owners Additional parcels for evaluation: 372, private owners		Approximate Size: 4.4 ha for the sum of all plots		
Map:					

Site description sheets for all potential plots

Criteria	Sum values	Sum scores	Scores %
LAND STATUS	9	19	14.39
Plot availability	2	4	3.03
Clean and clear title	2	4	3.03
Plot price	2	4	3.03
Time for acquisition and expected challenges during acquisition	2	4	3.03
Cost of development	1	3	2.27
CONNECTIVITY	4	8	6.06
Distance from transport, industrial and other relevant infrastructures	2	4	3.03
Distance from populated areas	2	4	3.03
RAW MATERIALS AND SERVICES	4	8	6.06
Availability of raw materials	2	4	3.03
Proximity to service providers	2	4	3.03
PHYSICAL FEATURES	15	33	25.00
Plot size and shape	1	3	2.27
Topography	1	3	2.27
Shaft depth	1	3	2.27
Drainage conditions	2	4	3.03
Surface (soil) conditions (from sensibility sheet)	2	4	3.03
Water resources	2	4	3.03
Accessibility	2	4	3.03
Subsurface conditions (physical)	2	4	3.03
Subsurface conditions (regulatory)	2	4	3.03

Multi-criteria analysis for all sites and the entire scenario

N°	Commentaires	Photo miniature	Latitude (DD)	Longitude (DD)
001	Les photos correspondent à la partie Est du site. Les courbes de niveau sont parallèles à la RD 5. Les parcelles sont à peu près horizontales au niveau des prairies disposées le long de la RD : elles pourraient recevoir des bâtiments associés au puits, sauf dans les parties boisées plus pentues. Les milieux ouverts sont occupés par des systèmes prairiaux mésotrophes récemment fauchés de bonne valeur agronomique. La flore est banale avec la présence d' <i>Arctium nemorosum</i> , <i>Symphytum officinale</i> , <i>Silene latifolia</i> , <i>Heracleum sphondylium</i> , <i>Hypericum perforatum</i> , <i>Mentha longifolia</i> , <i>Prunella vulgaris</i> , etc...		45,989350	6,248630
002	La lisière avec la forêt mixte est plus riche avec la présence d'espèces moins courantes : <i>Hylotelephium anacampseros</i> et <i>campanula trachelium</i> , notamment.		45,989515	6,248748
003	Aucune espèce protégée n'a été observée.		45,989325	6,248973

Site visit descriptions (Cerema SCOUT)

File system (EOS, CERNBox) for all data gathered

Scenario overview

Scenario key characteristics

Circumference	Circumference in km
Multi criteria analysis rating	Number of points (Percentage rating)

Advantages	Disadvantages
1	1
2	2
3	3

Value for the science programme

Describe the value of this scenario for the science programme, including the connectivity to existing particle accelerators and strategic sites to existing locations.

Subsurface conditions

Summarise briefly the sub-surface conditions along the entire circumference

Urbanism

Overall scenario description (TWiki, english + french)

J. Gutleber
A.L. Verdier

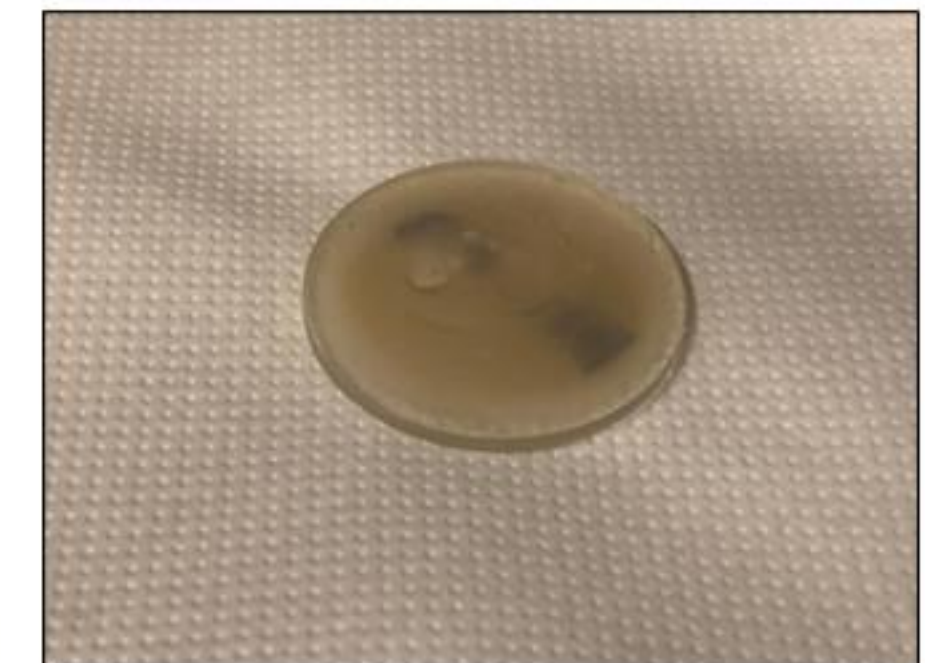
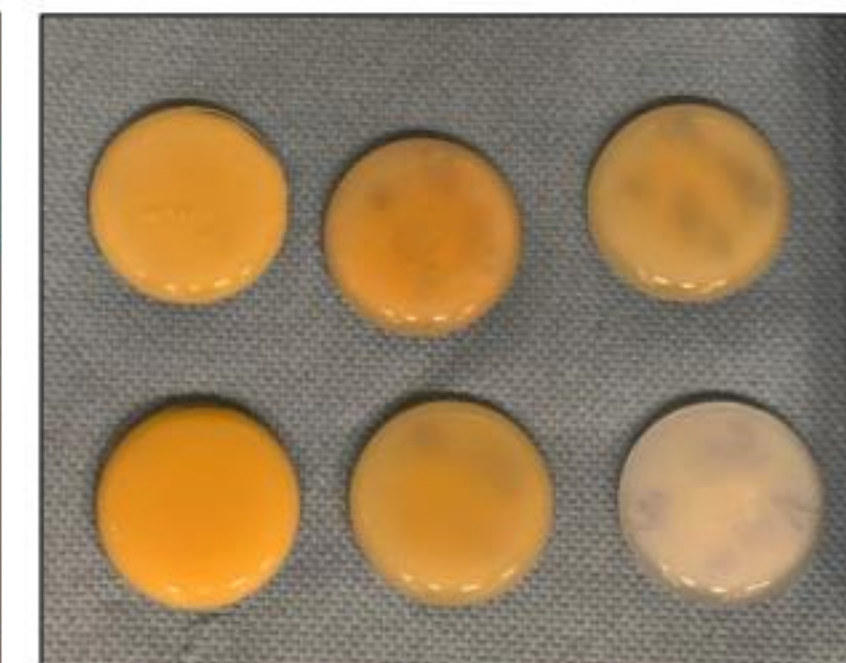
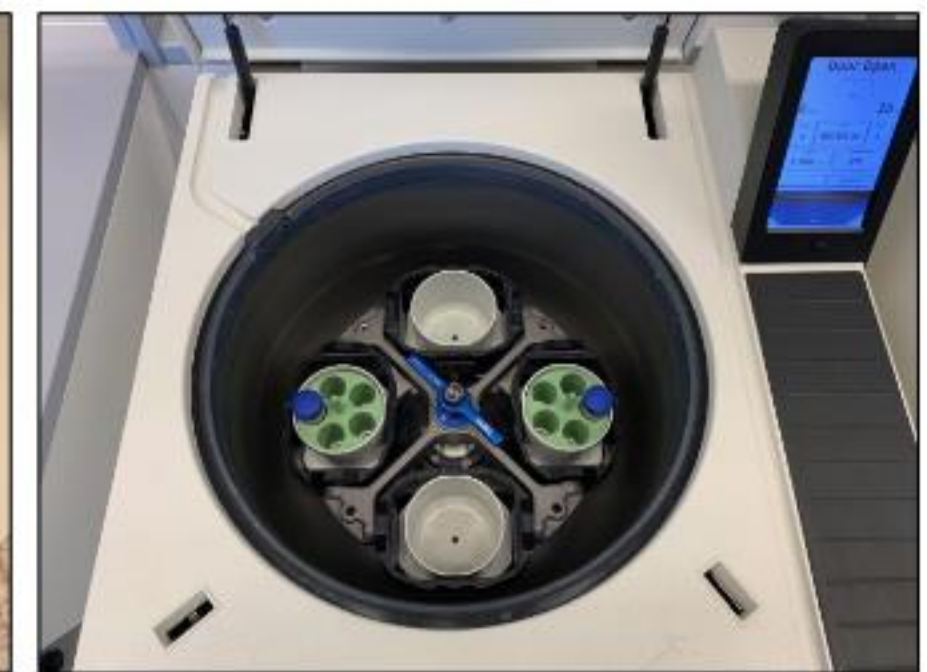
J. Gutleber

Impressions from molasse material sampling

- **Established collaboration agreements in the frame of FCC with:**
 - ETH Zürich
 - Montanistic University of Leoben
 - University of Geneva
- **Established contract with french company SETEC to create a map of potential materials re-use clients in the region.**
- **Provides input to Mining the Future competition**



Gathering of history bore samples from different areas in the region (M. Haas, CERN and MUL)



Impression from the XRD sample preparation for the analysis (M. Haas, CERN and MUL)

Thank you for questions and comments.