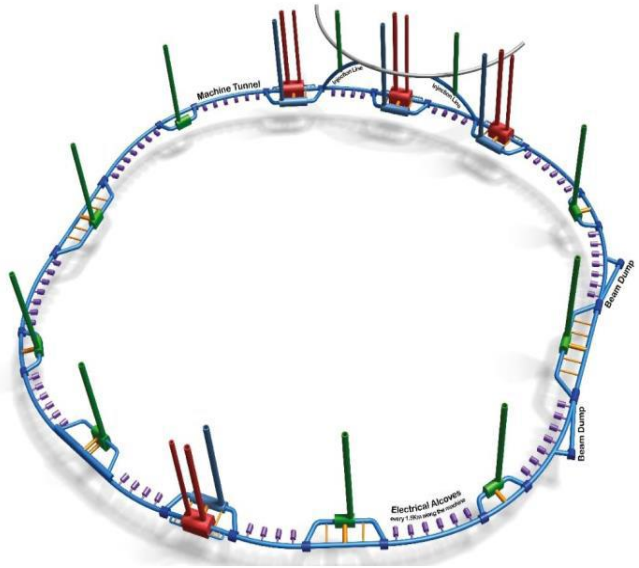


MINING THE FUTURE | MOLASSE IS THE NEW ORE

JEREMY VOIRON (BG) / ETIENNE GARIN (BG) / ERIC BUREAU (CIRCUL**ère**) / MATTHIAS BUERKI (VIGIER) / MATHIEU ANTONI (VIGIER) / JULIE PHAN (VIGIER) / LAURY BARNES-DAVIN (VICAT) / BERTRAND FAYOT (INDUNI) / BENOIT CHAMPEAU (MS) et al.

NATHALIE MONIN (BG) / CHRISTOPHE CARRON (PRA ING) / PATRICK HECK (BG)

www.bg-21.com

■INGENIOUS SOLUTIONS

OUR JOINT VENTURE

CIVIL ENGINEERING OFFICE, SPECIALIZED IN INFRASTRUCTURE, BUILDING AND ENVIRONMENT

INTERNATIONAL AND MULTI-LOCAL CEMENT GROUP

VICAT SUBSIDIARY DEDICATED TO THE CIRCULAR ECONOMY

CONCRETE AND MATERIALS TESTING LABORATORY

SWISS MATERIAL AND CEMENT GROUP

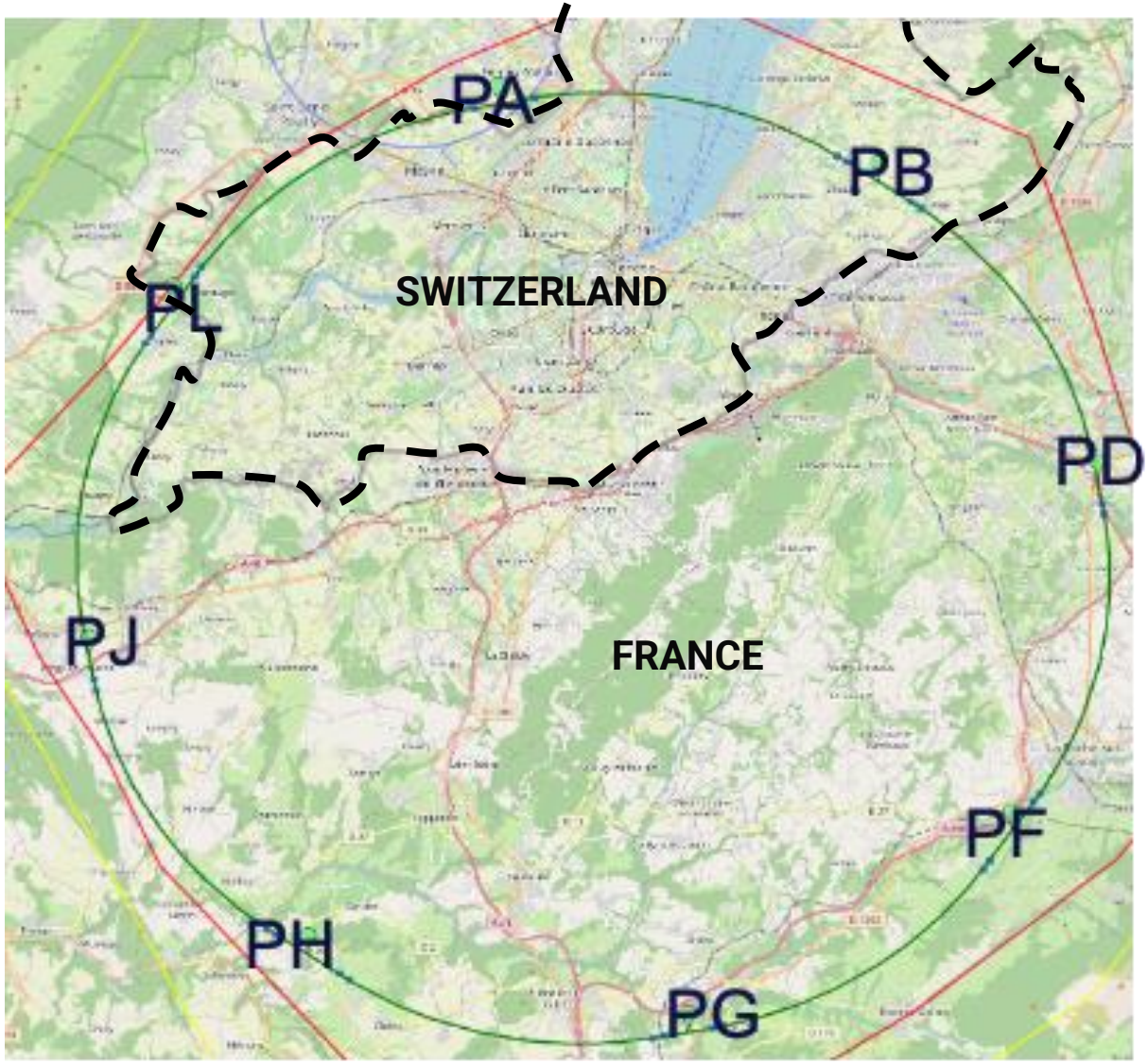
MANUFACTURE OF INDUSTRIAL MACHINERY, INNOVATIVE SOLUTIONS AND SERVICES FOR WATER CONSERVATION AND SAND RECOVERY

SWISS CONSTRUCTION COMPANY IN THE LAKE GENEVA AREA

CIVIL ENGINEERING OFFICE, SPECIALIZED IN SPOIL MANAGEMENT

MOLASSE IS THE NEW ORE

Type	Designation	For 1 m3 of Molasse	Technical feasability	Recovery channels	Economic viability	Societal value	Project relevance
Unpolluted Molasse	> 20 mm: Blocks of sandstone	≈ 18%	- Granulometric sorting. **(TRL 8)**	- Crushed to generate sand particles, and mixed with washed natural fine sand of the molasse to constitute a concrete sand 0/4 mm.	- Competitive price, annual quantities not sufficient to destabilise the local market. - Sorting costs: 5,5 €/ton, - Investment costs: 2,5 €/ton, - Stockpile costs: 0,5 €/ton, - Transport costs: 12 €/ton, - Market value: 25 €/ton.	- Circular economy.	- Huge range of possibilities of material valuation, - Circular economy.
	4 / 20 mm: Gravels / small blocks		- Screen (under water spraying). **(TRL 8)**				
	2 / 4 mm: Coarse sand	≈ 12%		- Recombinated in 0 / 4 mm: Granular materials sector (concrete sand, coating sand, filtration sand, trench backfill, etc.).			
	500 µm / 2 mm: Middle sand						
	63 µm / 500 µm: Fine sand		- Cyclonic sifter (patented equipment) for the 1mm size. **(TRL 8)**				
	15 / 63 µm: Silt particles	≈ 12%	- Hydro-cyclones, dewater. **(TRL 8)**	- Granular materials sector (filler complement for coarse sands).			
	< 15 µm: Clay particles	≈ 36%	- Filter press (with polymere when needed). **(TRL 8)**	- Activated clays for the production of low carbon cement. **(TRL 6)**	- Economic viability: very promising that could also be used on the FCC site, - Sold on the local market. - Needs 100 €/ton to balance budget, Clay available at a price of 8,5 € per ton on production site or 20-21 € /ton in the neighborhood.	- Creation of industrial jobs and the promotion of a promising environmental sector, - Circular economy.	
		≈ 12%		- For clays that cannot be activated, mixed with 0/1 mm sands to obtain earth concrete or bricks in terra cotta **(TRL 5)**.	If demand is assessed, we aim for economic viability: obvious and assured.	- New construction trend, - Circular economy.	
Polluted Molasse due to hydrocarbons	Heavily polluted molasse	≈ 10%	-	- Cements plants **(TRL 9)**	- Demonstrated since previous CERN projects	- Circular economy.	
				- Bioremediation **(TRL 9)**.	- Increasing the cost.		-
Limestone	-	-	-	- Filler for the production limestone cement.	- Logistical costs are minimised.	- Reintegrated into the life cycle of unpolluted molasse materials.	- Possibilities of material valuation, - Circular economy.
Water	-	-	- Water treatment plant (a thickener), - Using oil separators or other complementary water treatment.	- Recycled, - Remove hydrocarbons.	-	- Water is ensured with the planned sorting plant: more than 90% of water will be re-used.	-



FUTURE CIRCULAR COLLIDER

SUMMARY OF ESTIMATED EXTRACTED VOLUMES BY SITE AND BY YEAR

	Exit Point (Exit Country)									
Year	**A (CH)**	**B (CH)**	**D (F)**	**F (F)**	**G (F)**	**H (F)**	**J (F)**	**L (F / CH)**	**Sum (m3)**	**Sum (to)**
1	80 326	73 186	16 072	57 464	23 759	58 713	72 554	119 489	**501 563**	**1 203 751**
2	327 043	303 296	290 849	114 929	149 409	240 378	82 771	280 891	**1 789 566**	**4 294 959**
3	354 197	282 570	221 372	187 648	80 310	470 912	374 716	332 037	**2 303 762**	**5 529 030**
4	40 078	197 647	197 094	284 351		285 669	305 203	85 727	**1 395 769**	**3 349 845**
5			31 029	47 472					**78 501**	**188 402**
Sum (m3)	**801 644**	**856 699**	**756 416**	**691 864**	**253 478**	**1 055 672**	**835 244**	**818 144**	**6 069 161**	
Sum (to)	**1 923 946**	**2 056 078**	**1 815 398**	**1 660 474**	**608 348**	**2 533 613**	**2 004 586**	**1 963 545**		**14 565 987**

ASSUMPTIONS CONSIDERED:

- Estimated m3 in place (shafts, caverns, tunnels);
- Bulking factor: 1.5 to tend towards the 9 Mio m3 announced by CERN;
- Assumed: 2.4 t/m3 in place, or 1.6 to/m3 expanded.

MOLASSE SAMPLE

SAMPLE OF MOLASSE COLLECTED ON THE CERN HL-LHC POINT 1 SITE

(PREVIOUS CONSTRUCTION SITE)

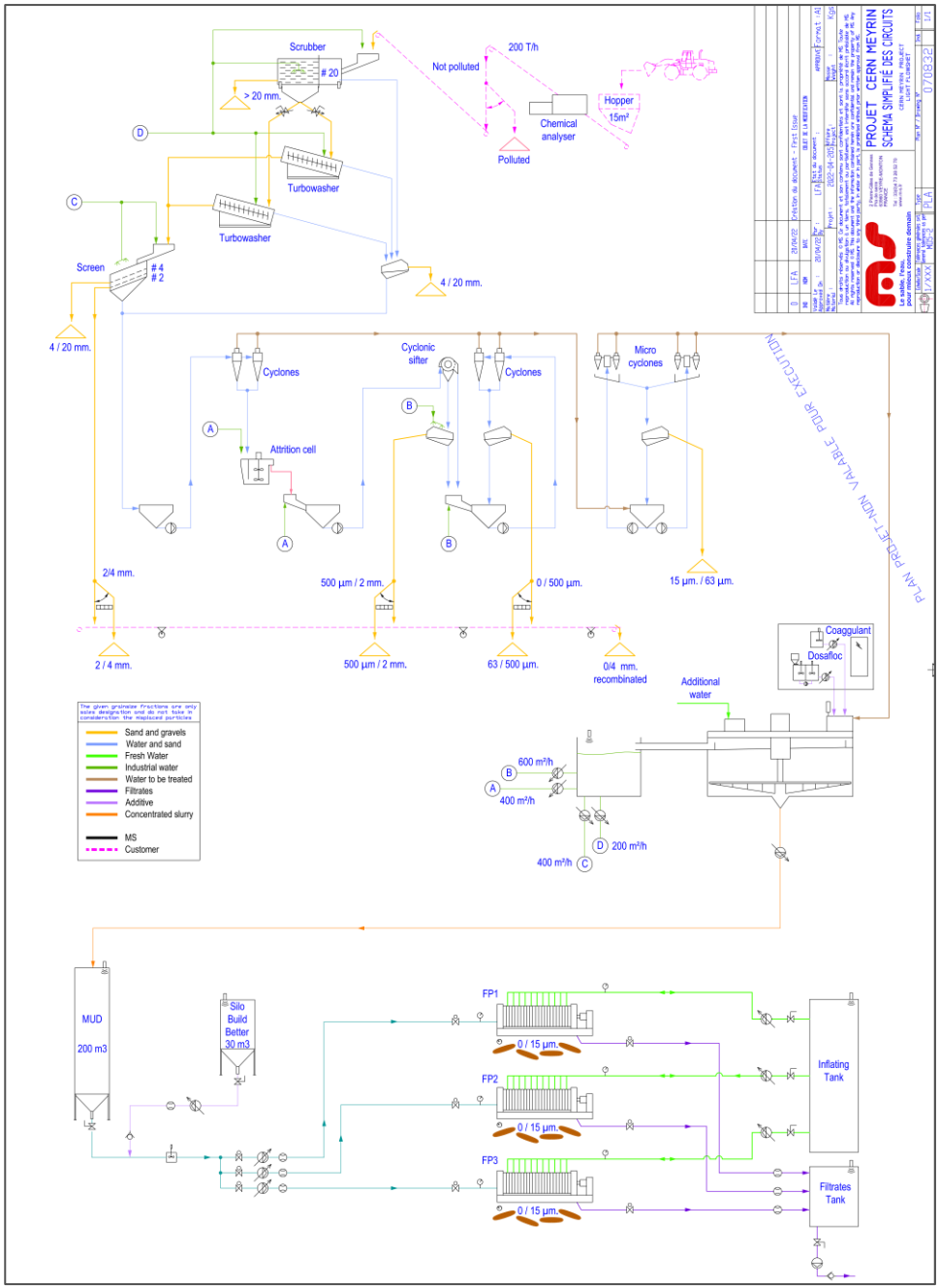
THE TESTS CARRIED OUT EXPECT THE FOLLOWING RANGE OF SPOIL GENERATED

- 36 to 48% clay particles which may be used to produce low carbon cement,
- 10 to 15% of silt particles which could be used as filler complement for coarse sands,
- 10 to 15% of sand particles from 63 µm to 4 mm that can be separated and blended to produce specific sands as concrete sand, coating sand, filtration sand, etc.
- 15 to 20% of particles over 4 mm which could be crushed to produce coarse sand.

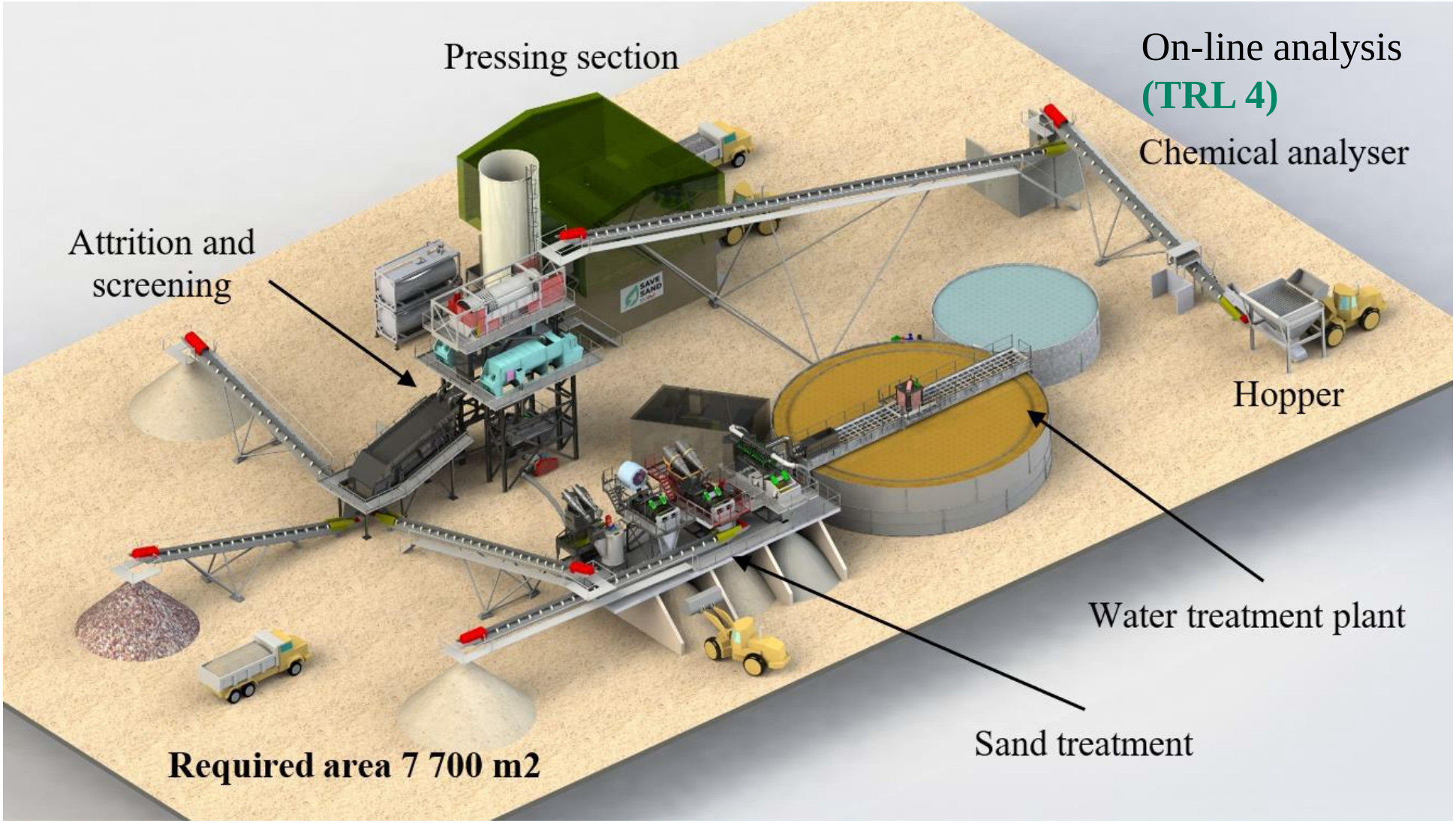
DIAGRAM HIGHLIGHTING THE PROCESSES ENVISAGED

The given grainsize fractions are only sales designation and do not take in consideration the misplaced particles

- Sand and gravels
- Water and sand
- Fresh Water
- Industrial water
- Water to be treated
- Filtrates
- Additive
- Concentrated slurry
- MS
- Customer



3D VIEW OF THE POTENTIAL MATERIAL SEPARATION PLANT



EXAMPLE OF GRANULOMETRIC SEPARATION PLANT

EXAMPLE OF WATER TREATMENT PLANT

EXAMPLE OF PLANT PROTECTION TO LIMIT NOISE AND DUST (OLD PORT OF NICE, 06 – FRANCE)

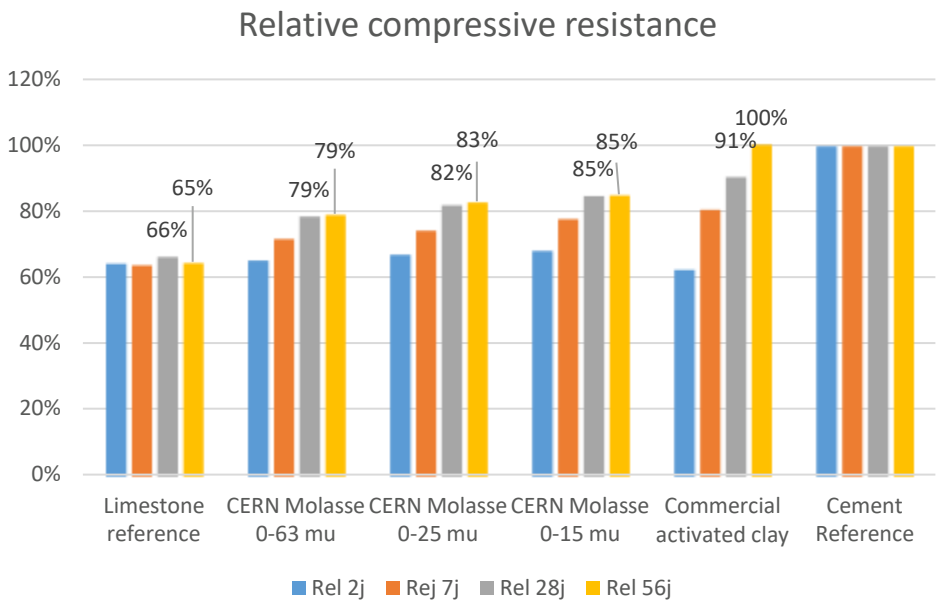
EXAMPLE OF MEASURES TO REDUCE NOISE AND DUST

CLAY ACTIVATION TEST - RESULTS

TECHNICAL ASSESSMENT

Hydrocycloning demonstrated enrichment of the clay fraction, the finer it is, the higher the amount of clay:

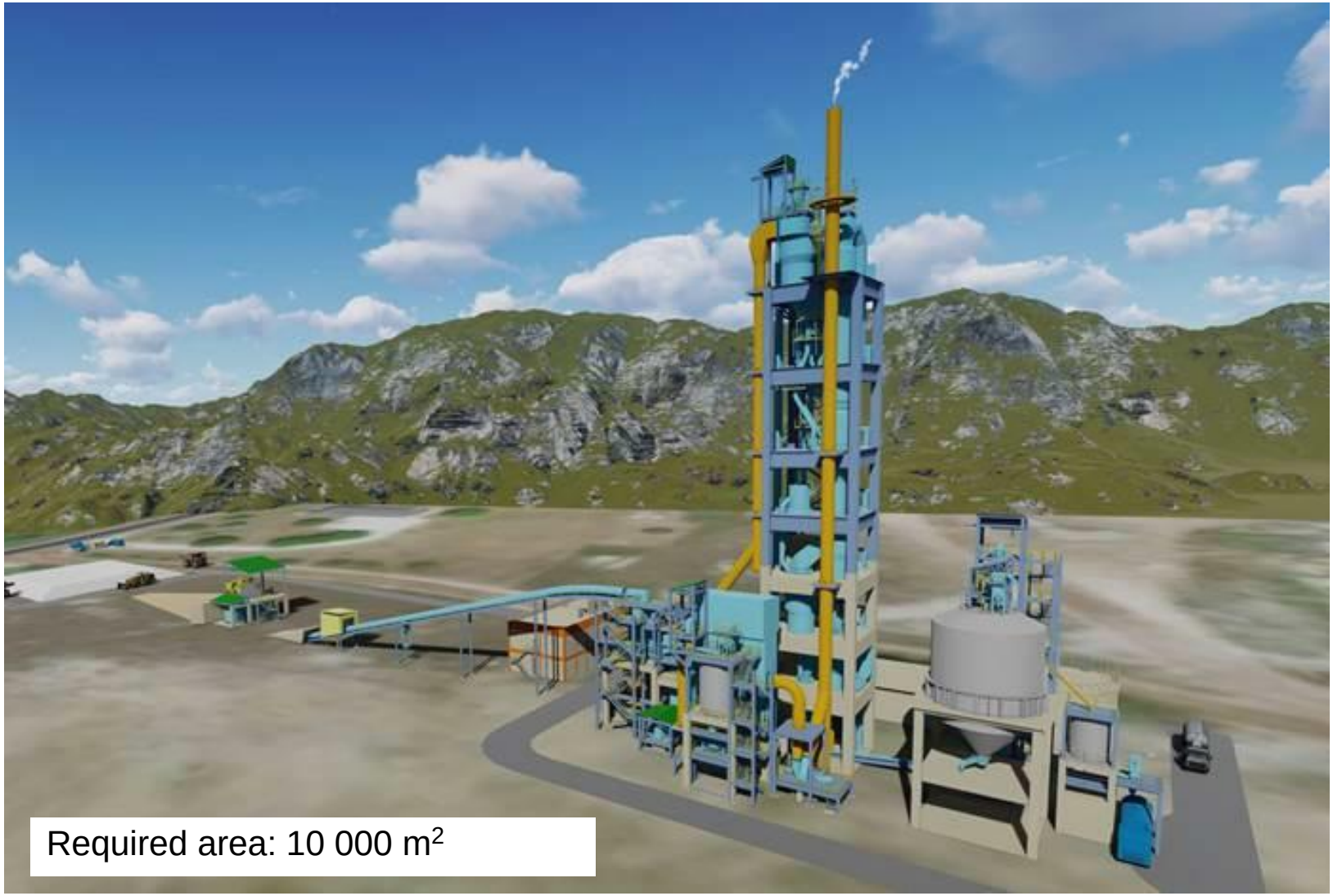
- At 28 days, the optimized thermal activation shows a moderate reactivity of the molasse,
- The finer the fraction, the better the strength obtained.



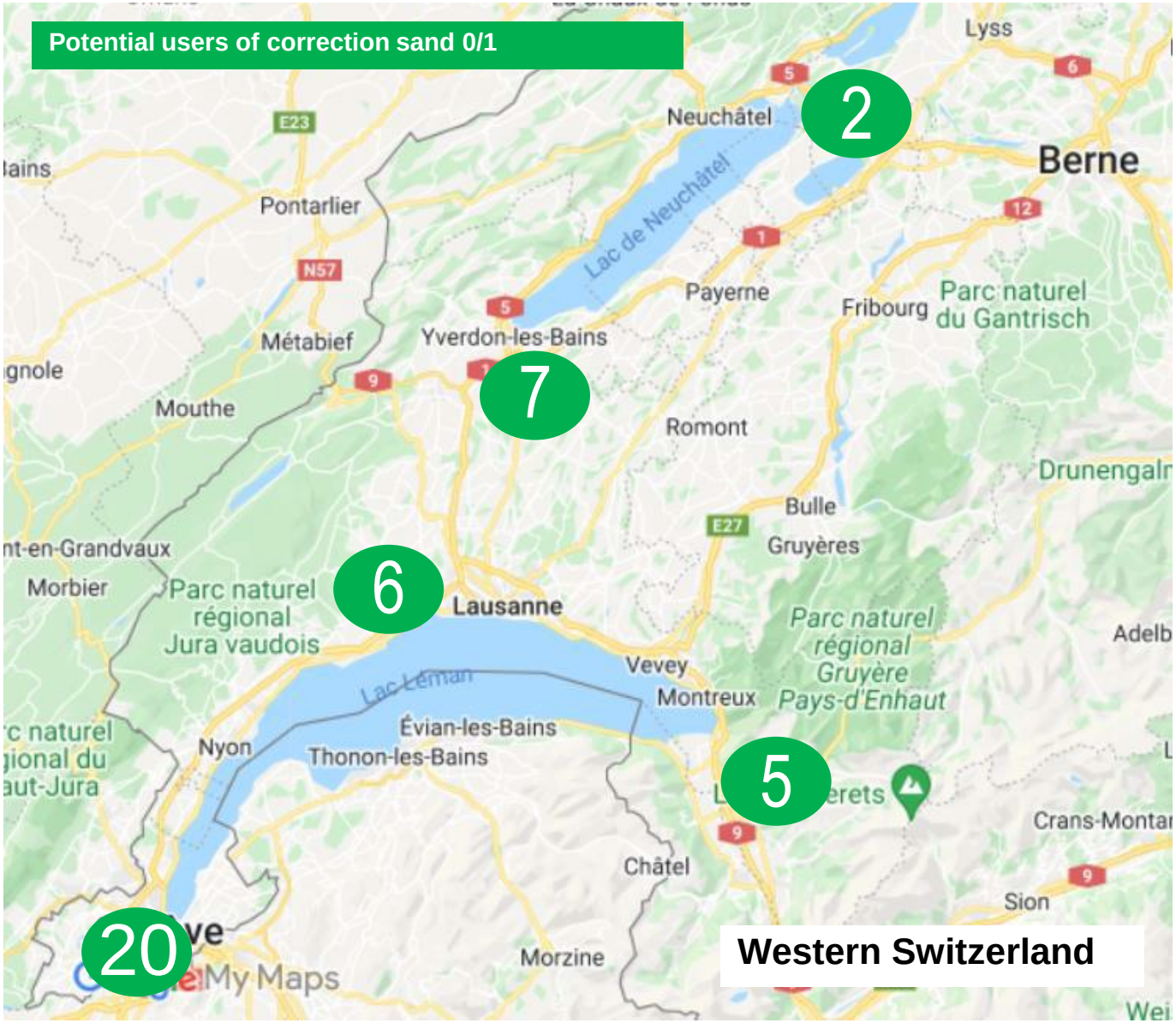
FINANCIAL & VOLUMES FIRST ASSESSMENT

- 1 M. Ton consumption over 10 years feasible – It is (only) 20% of the total amount available,
- The costs for material preparation, temporary storage and transport are likely to be similar or higher than the costs of direct final disposal: finances to be further investigated,
- Thermal activation in a flash calciner in France. Molasse is to be mixed with other more reactive materials,
- Investment cost to be amortized over 10 years,
- Incorporation in an innovative low-carbon cement, sold on the French / Swiss markets.

3D VIEW OF A TYPICAL FLASH CALCINATION PLANT FOR CLAYS



POTENTIAL USERS OF CORRECTION SAND 0/1



FINANCIAL ANALYSIS

MATERIAL SEPARATION PLANTS

- Raw production cost: processing only (excluding commercial and management services),
- Investment costs amortized over 3 years,
- Labor cost: 850 k€ per year.

⇒ Prospective production cost: **≈ 5 € per ton raw material** (energy and land costs to be added).

CORRECTION SAND 0 / 1 MM MARKET FOR CONCRETE PLANTS AND QUARRIES

- Sand 0 / 4 mm for the Lemanic area market:

  ⇒ 4 million tons a year.

- Lemanic area market absorption potential for the Correction Sand 0 / 1 mm:

  ⇒ 10 to 20 % of the 4 million of tons of sand 0 / 4 mm, equivalent to **≈ 600 000 tons,**
  ⇒ Potential selling price for road transportation (not yet evaluated for rail transportation):
  ≈ 25 € per ton (with a potential price increase of around 30% over 5 years).

- On the French market, the Correction Sand 0 / 1 mm should be limited to the needs of the construction sites.

CONCLUSION

TECHNICAL FEASIBILITY

- Possible reuse of ultra-fine fraction: the activation potential of the clay has been demonstrated,
- Possible reuse of sands and fine sands.

ORGANIZATION

- Installation size determination,
- Need for temporary storage (life of treatment plants, smoothing of the production curve).

SOCIETAL VALUE

- Area where molasse will be excavated and not only by CERN, synergies for the reuse of technical installations can be envisaged,
- Circular economy,
- Creation of jobs.

REQUIREMENT

- Deposit financial contribution to balance the budgets (from FCC Project).
  => To be balanced with the evolution of the carbon tax and the fuel market so uncertain.

THANK YOU FOR YOUR ATTENTION